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NEUTRON FLUX DISTRIBUTIONS DURING FIRST OPERATING CYCLE OF TRINO VERCELLESE REACTOR

by

G.P. BATTISTA and S. VALENZIANI
(ENEL)

1968

Report prepared by ENEL,
Ente Nazionale per l'Energia Elettrica, Rome - Italy

Euratom Contract No. 071-66-6 TEEI

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SUMMARY

This report presents the neutron flux distributions measured in the core of the Trino Vercellese Plant during the first core life by means of the incore instrumentation system called "Aeroball".

The Trino Vercellese Plant, known also as SELNI plant or E. FERMI plant, is provided with a pressurized light water reactor having a rated thermal output of 825 MW(t). Two turbine-generator units are installed having a gross capacity of 300 MW(e) corresponding to a thermal output of about 1 000 MW.

The knowledge of the neutron flux distribution is expected to provide valuable assistance in connection with the planned increase in plant rating up to saturation of turbine capacity.

This report also briefly describes the Aeroball system operation and discusses the methods used in the data correction and analysis and associated errors.

No attempt has been made to systematically compare experimental and theoretical results. The theoretical data presented in the report were mainly used to indicate trands and to help in presentation of experimental data.

KEYWORDS

NEUTRON FLUX
DISTRIBUTION
SELNI
POWER PLANTS
TURBINES
REACTOR CORE
ERRORS
CORRECTIONS
MEASUREMENT
INSTRUMENTS
IRRADIATION
TABLES

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NEUTRON FLUX DISTRIBUTIONS DURING FIRST OPERATING CYCLE OF TRINO VERCELLESE REACTOR (+)

1. DESCRIPTION OF THE SYSTEM AND OF ITS OPERATION

1.1 General

The Aeroball system constitutes the in-core instrumentation of the Trino Vercellese reactor, Italy, which is to provide information on the neutron flux distribution in the core. For this purpose, the activity induced by the flux is measured using movable probes introduced into the reactor. The system is made up of two parts : a section for irradiation, and a readout section for activity measurements.

1.2 Irradiation section

At the center of 30 of the 120 fuel assemblies forming the core there is a thimble in which a column of small carbon-steel balls is introduced. Manganese is added to the carbon steel for the purpose of activation. Fig. 1 shows the symbols and locations of the fuel assemblies and Aeroball thimbles in the core.

The 30 instrumented locations are not concentrated in a particular area of the core, but are almost distributed at strategic points in the reactor lattice. Though the in-core instrumentation system has been designed assuming quarter core symmetry, the particular selected pattern has the advantage, against the more traditional approach of a fully instrumented quadrant, of detecting the whole core regardless of the degree of symmetry. This becomes valuable if refueling schemes or control rod programming not involving high degree of symmetry will be used. Tilt detection is also improved. Finally, the selected pattern avoids neutron flux tilts due to concentration of instrumented fuel assemblies in one quadrant.

Fig. 2 gives a schematic representation of the system. Each thimble holds two adjacent tubes : one (1.5 mm dia.) in which the balls move in the two directions (Aeroball tube) ; the other (2.3 mm dia.) is provided for the introduction of in-core chambers.

(+) Manuscript received on March 4, 1968.

At the beginning of the measurements, a nitrogen stream pushes the column from the holdup section through the Aeroball tube and into the respective fuel assembly. The length of the column is slightly greater than the core height and the balls are held at the bottom by a crimp in the tube. The balls are then irradiated for the duration predetermined by the operator. At the end of the irradiation period, a nitrogen stream is sent into the gap between the thimble wall and the inner tubes, and hence it enters the Aeroball tube through the bottom. Thus, the nitrogen stream pushes the column back into the holdup section.

For each of the 30 measurement channels, two indipendent sets of balls are provided to permit two measurements to be taken in rapid succession. The set to be irradiated is selected by means of the diverter valve R1 (Fig. 2). The two sets are called A and B.

1.3 Readout section

When irradiation is completed -- an operation which can be carried out on all the channels simultaneously -- the gamma activity induced in the Mn-55 (half-life 2.58 hrs) by the neutron flux is measured. By means of the diverter valve R2 (Fig. 2) the selected column is pneulatically blown to the readout section (Fig. 3).

This section consists of a rotating table along the circumference of which the balls coming from the Aeroball tube arrange themselves. A synchronous motor turns the table over a scintillation counter which reads out the activity of 16 balls at a time. The readout signal is sent to a picoammeter designed for several different ranges. The picoammeter is connected to a recorder which maps the activity of the column. Before the column is scanned, a reading is taken of the activity of a Co-60 source which is fixed on the table in such a position as to precede the column over the scintillation counter.

At the same time, the operator can make use of the on-line Prodac-510 computer which memorizes 50 activity values of the column taken at regular intervals. By means of these values and appropriate computer programs, the computer processes the data provided by the Aeroball system and gives the desired information on power distribution.
When the activity of the whole column is read out, the balls are blown backwards and pushed into the holdup section. The coupling between the stationary tube and the tube on the rotating table is provided by a rotating joint.
The activities induced in all the irradiated columns are scanned and recorded in the sequence selected by the operator to obtain the corresponding maps. From each complete measurement (run), up to 30 maps can be obtained which give the activities proportional to the neutron flux at the center of the 30 elements.

2. AEROBALL DATA COLLECTION AND PROCESSING

2.1 Data characterizing core and Aeroball system conditions during an Aeroball Run (A. R.)

These include :

a) Core thermal output (*)
b) Control rod position (**)
c) Boron concentration in the coolant
d) Alkali concentration in the coolant
e) Core irradiation level
f) Average temperature in the four loops of the cooling system
g) Temperature difference between hot and cold leg in the four loops
h) Readings of the 6 nuclear chambers
i) Duration of ball irradiation
j) Aeroball system picoammeter range

(*) In this report, reference is often made to the gross electric output. The thermal output is obtained from the gross electric output by dividing the latter by 0.305 (average gross plant efficiency).

(**) The control rod position is normally expressed in this report in steps. Rods all out correspond to 263 steps; rods all in correspond to 0 steps.

k) Aeroball system photomultiplier voltage

i) History of power variations and control rod movements in the three days preceding the A. R.

2.2 Aeroball Raw Data

These include :

a) The axial activity maps recorded

b) Computer printouts (for each Aeroball) giving :
   - 50 activity readings at regular intervals
   - background reading in the absence of balls
   - readout time

c) Data concerning plant conditions at the beginning of irradiation (snapshot).

Attachment 1 shows two profiles obtained from the recorder charts and relating to two different A. R. 's. Attachment 2 shows a typical computer printout with an explanation of the data.

2.3 Aeroball Data Reduction

2.3.1 Background and decay corrections

The value corrected for background, decay and residual activity, if any, of the activity of Aeroball J in the axial position n for an infinite irradiation time is given by the following formula :

$$I_{Jn} = \frac{(A_{Jn} - B_g) - A_p \left[e^{-\lambda(t_e - t_{ep})} \right]}{\left[e^{-\lambda(t_e - t_{out})} \right] \left[1 - e^{-\lambda(t_{out} - t_{in})} \right]}$$

where :

A_{Jn}	ordinate at point n of the activity map
t_{in}	time at which irradiation of all the columns begins
t_{out}	time at which balls leave the core
t_e	time at which the scanning of a column on the rotating table begins
t_{ep}	time at which the same column was read in the preceding A. R.
B_g	background correction
A_p	A_{Jn} reading in the previous A. R.
λ	Mn-56 decay constant, equal to 0.0044864 min^{-1}

2.3.2 <u>Instrument drift correction</u> (*)

To prevent the interpretation of the data from being altered by a possible instrumentation drift, starting from run 16A a correction was made as follows (monitor method). The reading of a given column of balls (monitor) is repeated every three columns and then corrected for background and decay. In the absence of a drift, the values should remain the same. Any observed differences are attributed to instrumentation drift.

The ratios between the average values of all the activity readings of the monitor and that of the first reading are plotted to obtain the variation of the correction factor C_J with time. The correction is made as follows : the integrated activity which was read at time t is divided by the corresponding factor $C_J(t)$.

The same method can be applied by plotting repeated readings of the source.

(*) Cfr ENEL Doc. 811.610.811/1, Quarterly Progress Report, No. 1 (June-September 1966).

2.4 Aeroball Data Analysis

2.4.1 Activity variation in an Aeroball as a function of irradiation

A comparison was made of the data obtained with the same Aeroball in different runs. Only the runs performed with Xe at equilibrium (i. e. constant power level and control rods position in the three days preceding the run) and rods withdrawn by more than 250 steps were considered, plus run 16 A which was performed with the control rod group at 193 steps. The axially integrated activities given by the computer and corrected as described in 2. 3 were referred to the same measuring conditions with regard to power, irradiation time and efficiency of the whole measuring channel in the following manner. For each A. R. a source reading was taken : the source value corrected for decay (S), was divided by the value corresponding to run 16A (S_{16}) taken as reference. Then, by dividing the integrated activities of an A. R. by the ratio S/S_{16} and the MWt at which the measurement was taken, we obtained absolute values which can be compared with those of other A. R. 's. It was not necessary to account for the ball irradiation time as it was the same for all A. R. 's (10 minutes).

Since the source was changed after run 36, the correction was not possible for the subsequent runs. The analysis was therefore limited to runs 16A (before which the source was changed), 24A, 27B, 31B, 32B, 33A and 35A. Unfortunately, the limited irradiation interval (2600-4250 MWD/MTU) did not allow the activity variations in a channel to be followed throughout one complete operating cycle.

The results obtained (see Sec. 3) are generally satisfactory, even though within the limits mentioned above. The consistency of the experimental points warrants the adoption of this method for the next reactor operating cycles.

2.4.2 Radial activity distribution

The activity values, axially integrated by the computer and corrected as described in 2.3, were normalized for each A.R. up to the 36th to the value corresponding to Aeroball 19.

For the A.R.'s following the 36th, the same procedure was adopted, but the activities were axially integrated manually because the computer was out of operation.

With these values of activity, maps were plotted to obtain the radial flux distribution in some of the runs. Moreover, these values were utilized to obtain the activity variation in one Aeroball as a function of the irradiation level, in view of the difficulty of comparing absolute values, as described in the preceding paragraph 2.4.1.

Runs 16A and 18B, performed with partially inserted rods and xenon at equilibrium, were dealt with separately as the integrated activities were calculated also for the axial area not affected by the control rods. Indeed, it was demonstrated that this partial integration leads to an activity distribution which is practically unaffected by the presence of the control rods. The partial activities were calculated on the basis of the data recorded by Prodac-510 computer.

The results relating to runs 1 through 15 were not considered because the correction for instrumentation drift was only introduced after run 15.

2.4.3 Axial activity distribution

The activity maps considered were normalized to the activity value averaged over the full core length. It was not necessary to make corrections for decay and instrumentation drift; the only correction made was a background correction. After this operation, it is possible to detect any differences due to axial distorsions by overlapping the maps pertaining to different runs.

The normalized maps of a single run appear to be almost identical for the runs with withdrawn rods, whereas when the rods are inserted the related maps show differences which are sometimes quite significant.

The four Aeroball analyzed for each run are : Aeroballs Nos. 13 and 15 adjacent to a control rod on the boundary between the intermediate and center regions; and Aeroballs Nos. 7 and 22 -- both far from the control rods -- located respectively at the core periphery and at the center.

2.4.4 Processing of the results of run 38B

This run was performed at 9850 MWD/MTU and it is the only one for which a complete comparison was made with the theoretical data computed by the fuel element designer and manufacturer (Westinghouse) for the same burnup level. The comparison was carried out with the procedure described herebelow.

On the basis of the following theoretical on-site computer input constants, the activity of the Aeroball was converted into terms of power of the various core assemblies :

$\frac{I_{ref}}{I_J}$ = ratio between the activity of the reference Aeroball and a generic Aeroball J (30 constants with rods all out);

$\frac{P_{ref}}{I_{ref}}$ = ratio between the average power of the reference fuel assembly and the activity in the reference Aeroball (1 constant);

$\frac{P_i}{P_{ref}}$ = ratio between the average power of fuel assembly i and the average power of the reference fuel assembly (30 constants)

If the axially integrated activities -- expressed in arbitrary units which are however consistent for the same run -- are denoted by I_J the power generated in assembly i is computed in arbitrary units by means of the following formula :

$$P_i = I_J \quad \frac{I_{ref}}{I_J} \cdot \frac{P_{ref}}{I_{ref}} \cdot \frac{P_i}{P_{ref}}$$

This method allows the power generated by any one assembly to be calculated by means of any Aeroball J. A quarter core symmetry was assumed. If in a fuel assembly (or its quadrant symmetrical correspondent) there is an Aeroball, the power of the assembly is calculated on the basis of the activity of that Aeroball. Instead, if there is no Aeroball or it is not operating, the calculation is performed by averaging the values obtained with the two or three nearest Aeroballs.

2.5 Summary of all the A. R. 's

For all the A. R. 's performed, Tables 1a through 1d give the significant data which characterize the conditions of the plant and Aeroball system during the performance of a run.

3. PRESENTATION OF THE RESULTS

3.1 Radial distribution

Tables 2a to 2h show the data relating to runs 16A, 19B, 24A, 27B, 31B, 32B, 33A and 35A.

The first column of each table gives the Aeroball number; the second, the value of the axially integrated activity corrected for background and elapsed time; the third, the correction factors C_J for instrumentation drift; the fourth, the integrated activity values corrected to account for instrumentation drift; the fifth, the integrated activities referred to the same measurement conditions and the same power level as indicated in 2.4.1; the sixth, the ratios between the integrated activities in the fourth column and that of Aeroball 19.

Tables 3a to 3e give the data relating to runs 37B, 38B, 39B, 40B and 42A. The second column of these tables shows the values of the activities axially integrated on the basis of the recorder charts and expressed in microamperes, corrected for elapsed time and background.

The maps in Figs. 4A to 4C give the ratios I_J/I_{19} derived from tables 2c, 2h and 3a relating to three runs performed at different core irradiation levels.

Figs. 5A to 5F give a comparison of the results in tables 2 and 3 with those obtained on a theoretical basis by FIAT under a complementary research program of the Enel-Euratom program.

Each section of these figures indicates the experimental data relating to octant-symmetrical Aeroballs. The theoretical curve is the same for each group of symmetrical Aeroballs as the calculations were practically performed for an octant symmetry. In order to point out any systematic differences between ball sets A and B, the respective set for each experimental point is identified. This method of presentation allows us to detect any tilts and spurious points due to great differences in flight times between column of different sets.

The analysis of the experimental data led to the conclusion that, in view of the absence of systematic differences between the results relating to Aeroballs located in different octants, the core octant symmetry is satisfactorily verified.

For runs 16A and 19B, which were performed with Xe at equilibrium and the control rods inserted at 193 and 223 steps respectively, the analysis was carried out according to the procedure described in 2.4.2. For these runs, Tables 4a and 4b give the integrated activities for the area unaffected by the control rods. The values of these activities referred to Aeroball 19 are compared with the corresponding total activity ratios, derived from Tables 2a and 2b, in Figs. 6A and 6B, where the influence of the proximity of the control rods on the radial activity distribution can be observed.

These results clearly show the necessity of limiting the calculation of the activity relating to runs performed with inserted rods only to the lower part of the activity profile, which is not affected by the control rods.

The results relating to run 38B, obtained as described in 2.4.3, are shown in Table 5 and Fig. 7, where the theoretical ratios P_i/P_{avg} are compared with the corresponding ratios calculated on the basis of the experimental data.

The comparison between the theoretical and experimental data at the same burnup level is completed in Fig. 8, where the activities referred to Aeroball 19, experimental (run 38B) and theoretical (computed by Westinghouse), are indicated.

The consistency between the experimental and theoretical data provided by the reactor designer -- which was already noted in the power comparison -- is confirmed by the low values of the percent deviations between theoretical and experimental activity data.

3.2 Axial distribution

Tables 6a and 6e give the maximum/average axial ratios for some of the runs. The last column in the table shows the axial position of the maximum, starting from the core bottom, expressed in fiftieths of the core height. Computer-processed data were used, but no correction was made for background in the presence of balls. It was also noted that there is not a perfect correspondence between the average activity value obtained graphically and the value provided by the computer. However, it is estimated that the resulting error is less than ± 3%.

Fig. 9 shows the maximum/average axial ratio F_z as a function of core burnup for a few Aeroballs, in runs performed with withdrawn rods and xenon at equilibrium, and for a few significant Aeroballs under various degrees of rod insertion. This ratio is practically constant for all the Aeroballs in the same run with withdrawn rods and xenon at equilibrium. In the other cases, this ratio differs for the various Aeroballs, and the Aeroball referred to is indicated.

In the same figure, we have indicated the theoretical variation of this ratio as estimated by FIAT for reactor operation with permanently withdrawn rods. It will be observed that the experimental points relating to all-rods-out condition and comprised between 2000 and 4000 MWD/MTU all appear above the aforesaid curve. In fact, reactor operation with partially inserted rods during the initial operating period (up to about 2600 MWD/MTU) affected the axial burnup distribution, causing an upwards shift of the axial peak with a consequent increase in the maximum/average ratio.

For the runs with all-rods-out, the F_z ratio decreases constantly from 1.39 to 1.16 as the burnup rises from 1180 to 10038 MWD/MTU. For runs with partially inserted rods, this ratio is strongly dependent on the position of the rods, and it may increase considerably (approximately up to 2 for Aeroball 13 of run 14).

To show the quantitative effect of the control rod position, burn-up level and Aeroball position on the axial distribution under different operating conditions, Figs. 10A, B and 11A, B are incorporated in this report.

Fig. 10A shows the data relating to A. R. 14B, performed with the control rods at 88 steps, 80 MWe, 2600 MWD/MTU. This was the run with the highest rod insertion. A comparison was then made of Aeroball Nos. 22, 13 and 15. Of these, Nos. 13 and 15 are located near a control rod, whilst Aeroball 22 is located at the center, far from the control rods. This different position is reflected very clearly in the axial distribution. Furthermore, Aeroball 13 is affected by the proximity of the control rod more than Aeroball 15, and this is confirmed in the other runs.

Fig. 10B, shows the maps relating to Aeroballs 13 and 20 in run 18A. This run was performed with a lower degree of rod insertion (199 steps), at 150 MWe, 2690 MWD/MTU.

Aeroball 13 is near a control rod, whereas Aeroball 20 is far from it. The figure shows a different skewing of the profile for the two cases caused by the partial insertion of the control rods.

Fig. 11A, with the maps relating to Aeroball 22 in two different runs, points out the effect of non-equilibrium xenon distributions. These are runs 9A and 10B which were performed under the same reactor operating conditions (2220 MWD/MTU, 126 MWe, 286 steps). A. R. 9 was performed 5 hours after complete rod extraction ; A. R. 10 was performed 44 hours later.

One can see that the peak has shifted considerably towards the core top and at the same time F_z has increased. The effect of xenon redistribution is slightly more pronounced in the Aeroballs nearer the rods.

Fig. 11B shows four activity maps which can be considered representative of the axial neutron flux distribution during the lifetime of the first core, with the control rods practically withdrawn and xenon at equilibrium.
These profiles reflect the particular manner in which the first core was operated, that is, with the ten rods of the control group inserted by about 1/3 of the active core length during the initial period up to about 2600 MWD/MTU.

The map of A. R. 6B, performed at 1580 MWD/MTU, shows that the asymmetry in the axial burnup distribution, due to operation with the control group partially inserted, causes only a slight skewing of the neutron flux towards the core top when all rods are withdrawn. In the profile of A. R. 10B, performed at 2250 MWD/MTU, neutron flux skewing is more pronounced.

The map of A. R. 35A, performed at 4257 MWD/MTU, indicates that operation with the rods practically all out for about 2000 MWD/MTU had already attenuated the asymmetry in the axial burnup distribution and consequently the upward skewing of the neutron flux. In addition, neutron flux flattening started appearing in this profile due to the higher burnup at the core center.

The map of A. R. 39B, performed at 10,038 MWD/MTU, is representative of the conditions at the end of the life of the first core. The higher burnup at the core center flattened the map considerably and was about to determine a depression at the center . It can also be noted that the axial peak has shifted towards the core bottom.

4. SYSTEM ERROR ANALYSIS

In order to assess the precision of the system, a few of the most likely causes of systematic errors were studied and are described below. It should be borne in mind that the values indicated for the maximum error due to the various causes were obtained from largely approximate estimates.

The reproducibility of the system has not yet been assessed.

4.1 Instrumentation drift

The method used so far to correct this cause of error was described in Paragraph 2. 3. 2. By a rough estimate, the maximum residual error of integrated activity after correction appears to be within 2%.

4.2 Differences in ball transit time through the core

Ball transit time causes an axial distorsion in the neutron flux because the balls in one column are not irradiated for the same length of time.

Both when entering and when leaving the core the balls at the bottom are irradiated longer than those at the top. To evaluate the effect of the different transit times on axial distribution, ball speed within the core was assumed to be constant. The nominal irradiation times considered were 1 and 10 minutes. The error calculated on F_z was less than 0.5% for 10-minute irradiation and 2,5% for one-minute irradiation.

It was then decided to use normal irradiation times of at least 10 minutes.

4.3 Differences in ball flight times

The differences in flight time, i. e. the differences in the time taken by the various ball columns to reach the core, lead to different irradiation times and therefore a distorsion in the radial activity distribution. This phenomenon was noted by systematic comparison of readings taken with the two sets A and B under the same conditions. The difference in flight time is probably due to a ball sticking in the crimp of some of the holdup sections. The holdup sections are now being replaced to eliminate this problem.

In one istance, the estimated difference in the flight times of sets A and B was such as to give rise to a maximum error of 6% on the value of activity. It has not been possible yet to evaluate the differences in flight times between balls of the same set and between different Aeroballs. A new procedure has been devised to measure flight times in future.

4.4 Short channels

The two channels, Nos. 15 and 23, are three inches shorter than the others. The resulting error is quite negligible owing to the low neutron flux at the two ends of the core.

4.5 Misalignment between ball columns, fuel and computer readout points

The relative positions of the three factors were determined. The calculation was based on the actual grid distance of 10.875 inches. This distance was checked against the distance which it was possible to derive from the recorder charts and from the point activity maps obtained with the computer. The systematic error, due to imperfect alignement in the core between the channels containing the balls and the microswitch on the readout table which determines the beginning of computer scanning, was calculated. This error tends to overrate the ratio between the maximum and average axial fluxes by not more than 0.6%.

4.6 Background (*)

The background in the absence of balls is automatically eliminated before each column is scanned. The residual error is normally

(*) Cfr ENEL Doc. 811.610.811/2, Quarterly Progress Report, No. 2 (September-December 1966).

very small.

The presence of balls on the readout table causes a further signal-error along the axial profile which cannot be eliminated. This error can be read at the edges of the axial profile around the reference source signal (see Attachment 1).

In the assumption that the activated balls give rise to the same effect as the source, the axial trend of this profile error was calculated and found to deviate by not more than 2% from the value at the edges of the axial profile.

Therefore, by subtracting from the entire activity profile the value read at the edges of the source, the residual error committed in the determination of the axial maximum/average ratio should never exceed 2%, and in the majority of cases it is less than 1%.

4.7 Other causes (wrinkling)

Wrinkling consists of discontinuities in the axial activity profile. Attachment 1 gives a profile with wrinkling and one without. The following observations were made :

1. Wrinkling is reproducible for an Aeroball of the same run scanned repeatedly (monitor).
2. For a given Aeroball, the wrinkles are reproduced in subsequent runs using the same set of balls.
3. For the same Aeroball, the wrinkles are not reproduced when the set is changed.
4. The reproduction of wrinkles in 2 above does not occur if the balls are changed.
5. Wrinkling appears in the form of dips rather than peaks.
6. Wrinkling started appearing at run 12. In the following runs, the number of ball columns in which it occurs increases

gradually . Once wrinkling has set it, it does not recede.

7. Up to and including run 35, only some of the ball columns were affected by wrinkling. In the subseqent runs, which were performed about one year later, wrinkling appeared on all columns.
8. The grid distance obtained from the activity profiles appears to remain constant and unaffected by wrinkling.

The most grounded assumption to explain wrinkling is that it is associated with disuniformities in the column of balls. Wrinkling could be attributed to a non-uniform linear density of manganese in the column of balls, due either to foreign bodies between the balls or to disuniform manganese concentration from one ball to another.

From the standpoint of radial distribution, wrinkling did not determine any inconveniences, notwithstanding its entity. However, from the standpoint of axial distribution it makes the analysis and comparison described in Paragraph 2. 6. 3 difficult to perform. For this reason, the analysis of the axial behaviour of the neutron flux in the runs following the 35th was carried out by tracing the envelope of the top part of the activity profile.

These corrections should practically eliminate the error due to wrinkling.

ACKNOWLEDGEMENTS

The authors wish to thank R. Casini, F. Cioli and P. Fornaciari of ENEL-DCTN for their encouragement and guidance.
They are also indebted to A. Camplani and to all personnel of Engineering Section of Trino Vercellese Plant for helping in data collection and discussion and to G. Cuttica of ENEL-DCTN for many valuable suggestions. The able efforts of Miss M. V. Leonori of ENEL-DCTN in preparing the English version of the report are gratefully acknowledged.

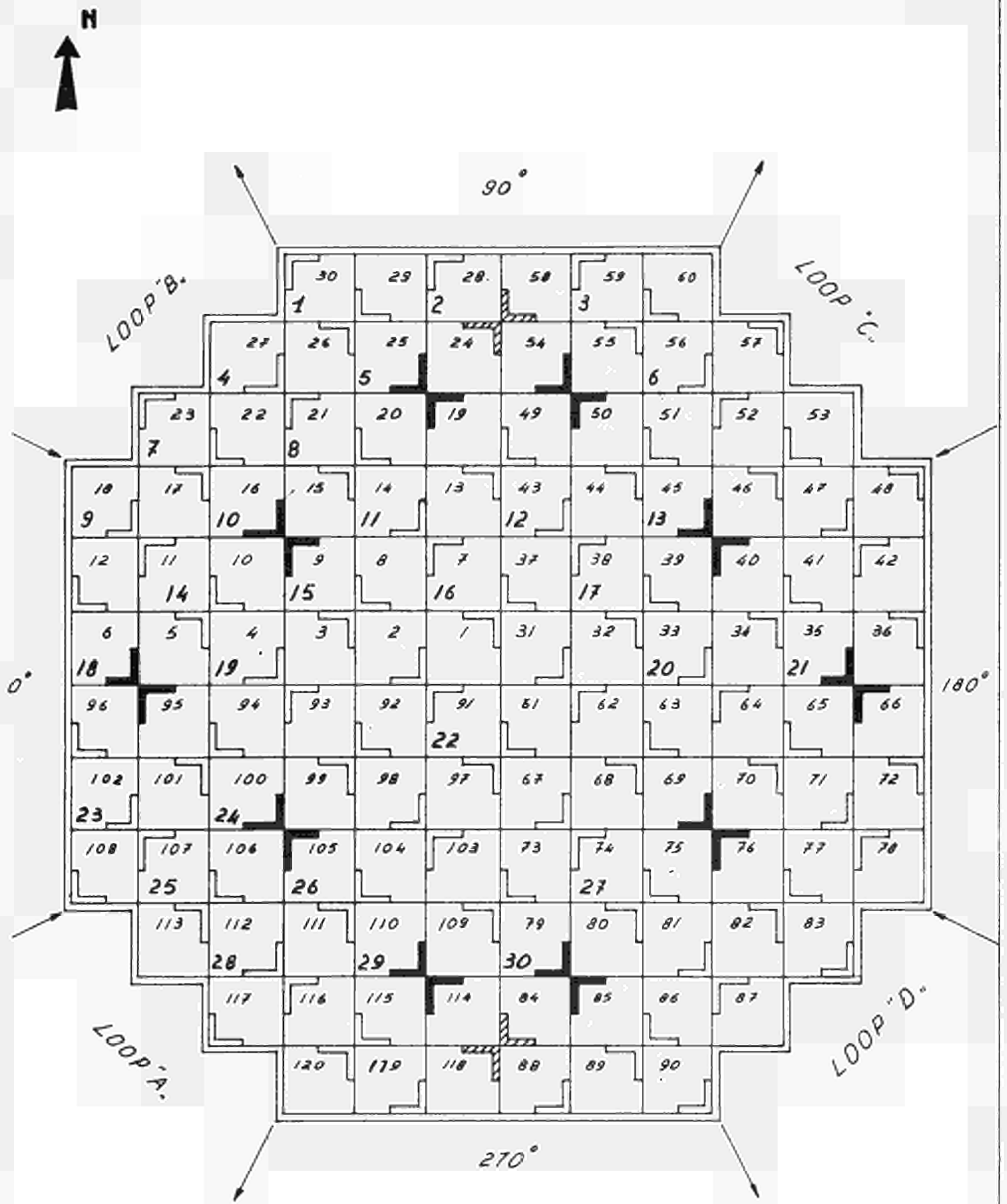


FIG. 1 CORE CROSS SECTION SHOWING IDENTIFICATION OF FUEL ASSEMBLIES AND AEROBALL THIMBLES

ENEL - D.T.C.N.	
Date: March - 30 - 1967	
Dftm: P.Z.	App: S.V.

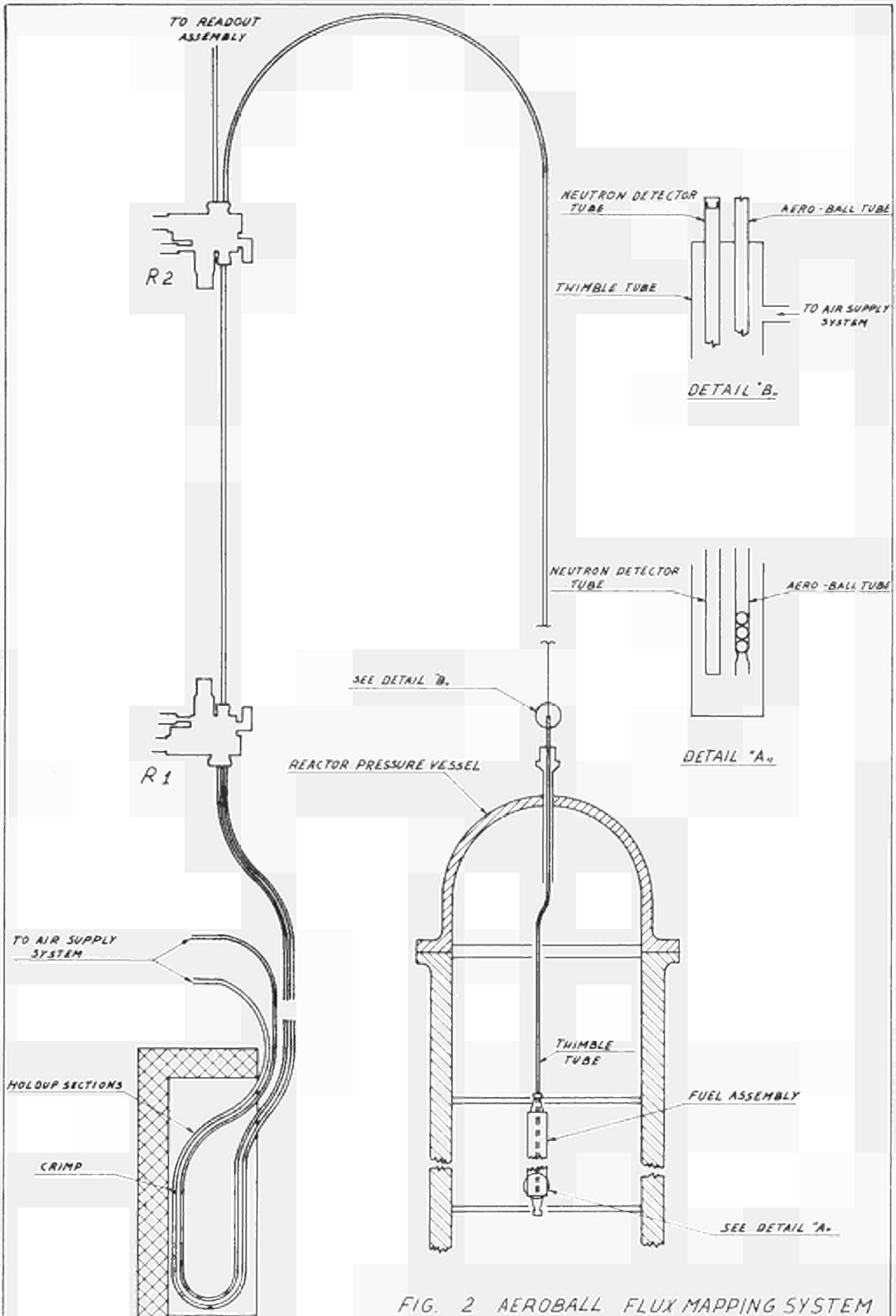


FIG. 2 AEROBALL FLUX MAPPING SYSTEM PICTORIAL DIAGRAM

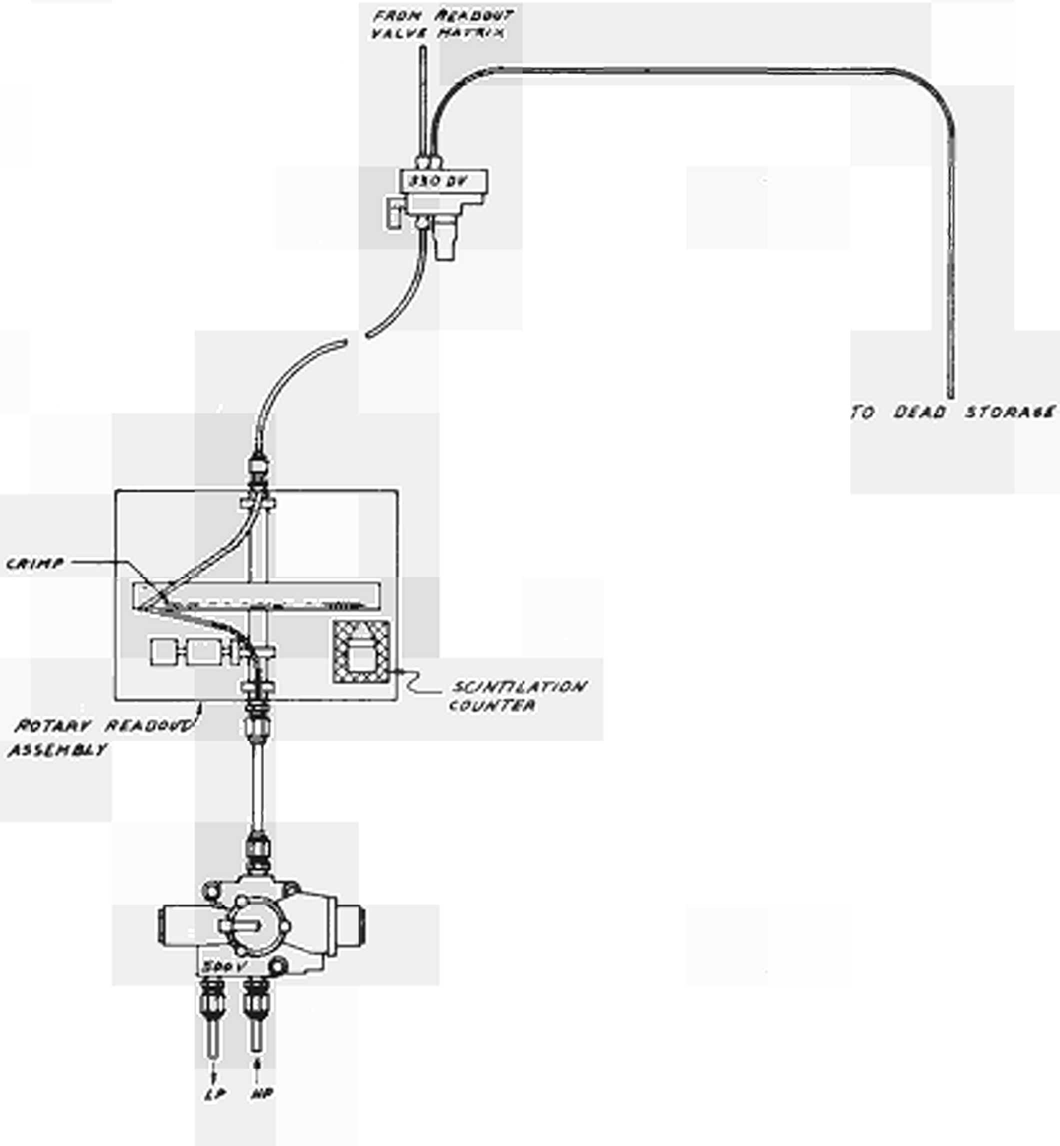
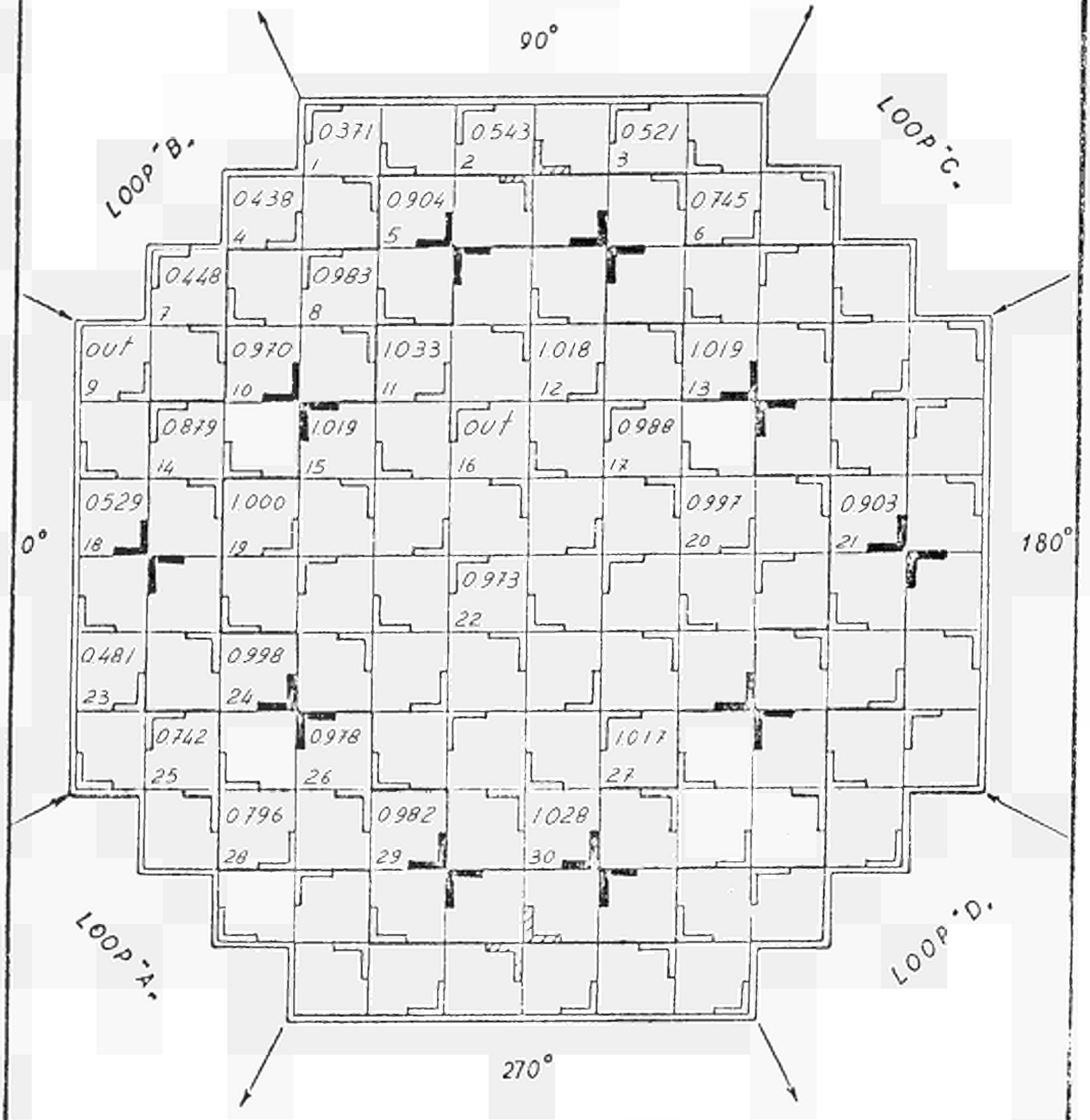


FIG. 3 AEROBALL READOUT ASSEMBLY
PICTORIAL DIAGRAM

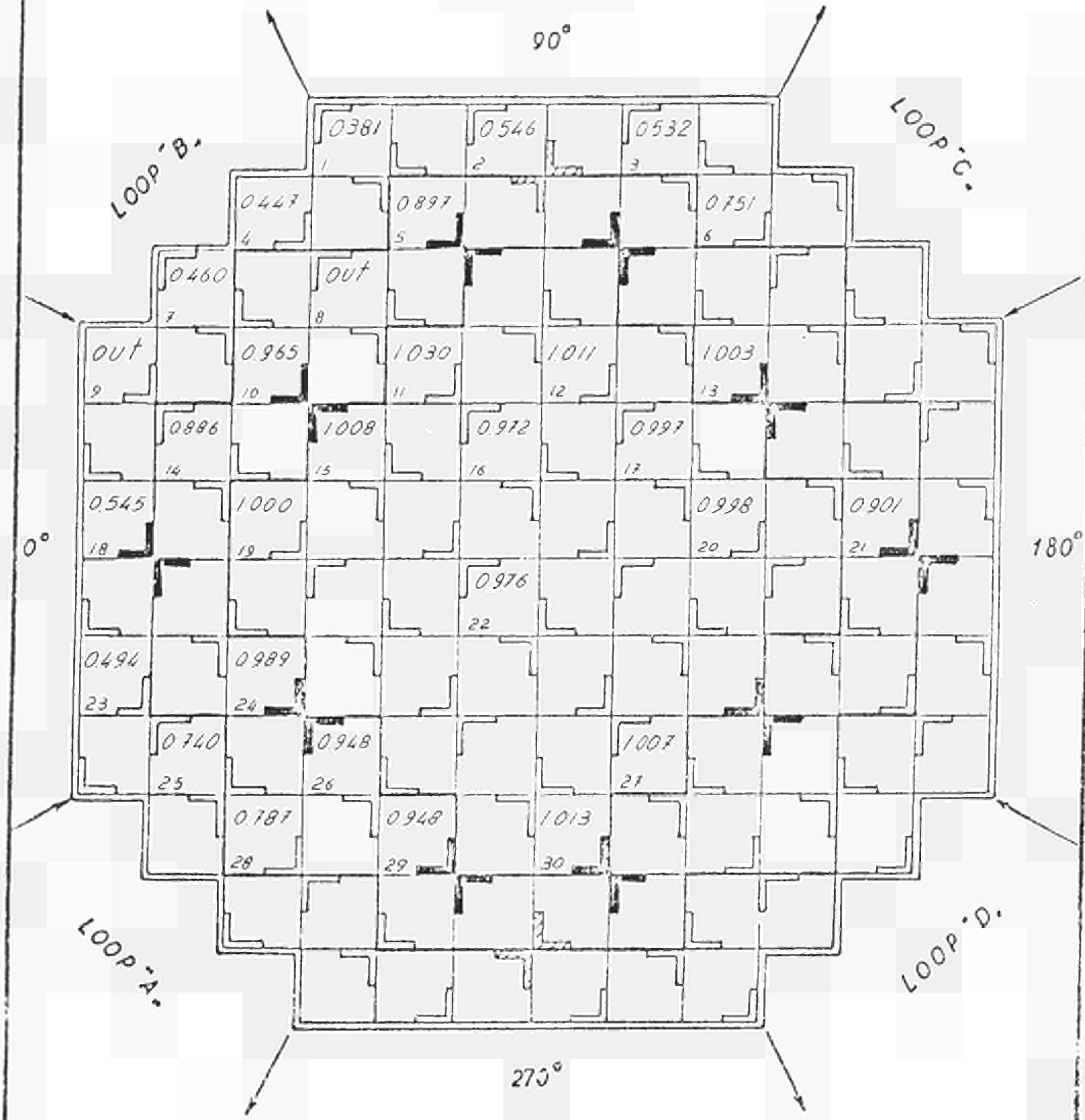
FIG. 4A RATIO OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL (No 19)



Aeroball Run N° 24A
Date OCTOBER 28 1965
Electrical Power Level, MW 220
Control Group Position, steps 265
Trim Group Position, steps 286
Irradiation Level, MWD/MTU 2803

ENEL - DCTN	
Date: April -4 -1967	
Dftm: P.Z.	App: S.V

FIG. 4B RATIO OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL (No 19)



Aeroball Run N° 35A

Date JANUARY 20, 1966

Electrical Power Level, MW 255

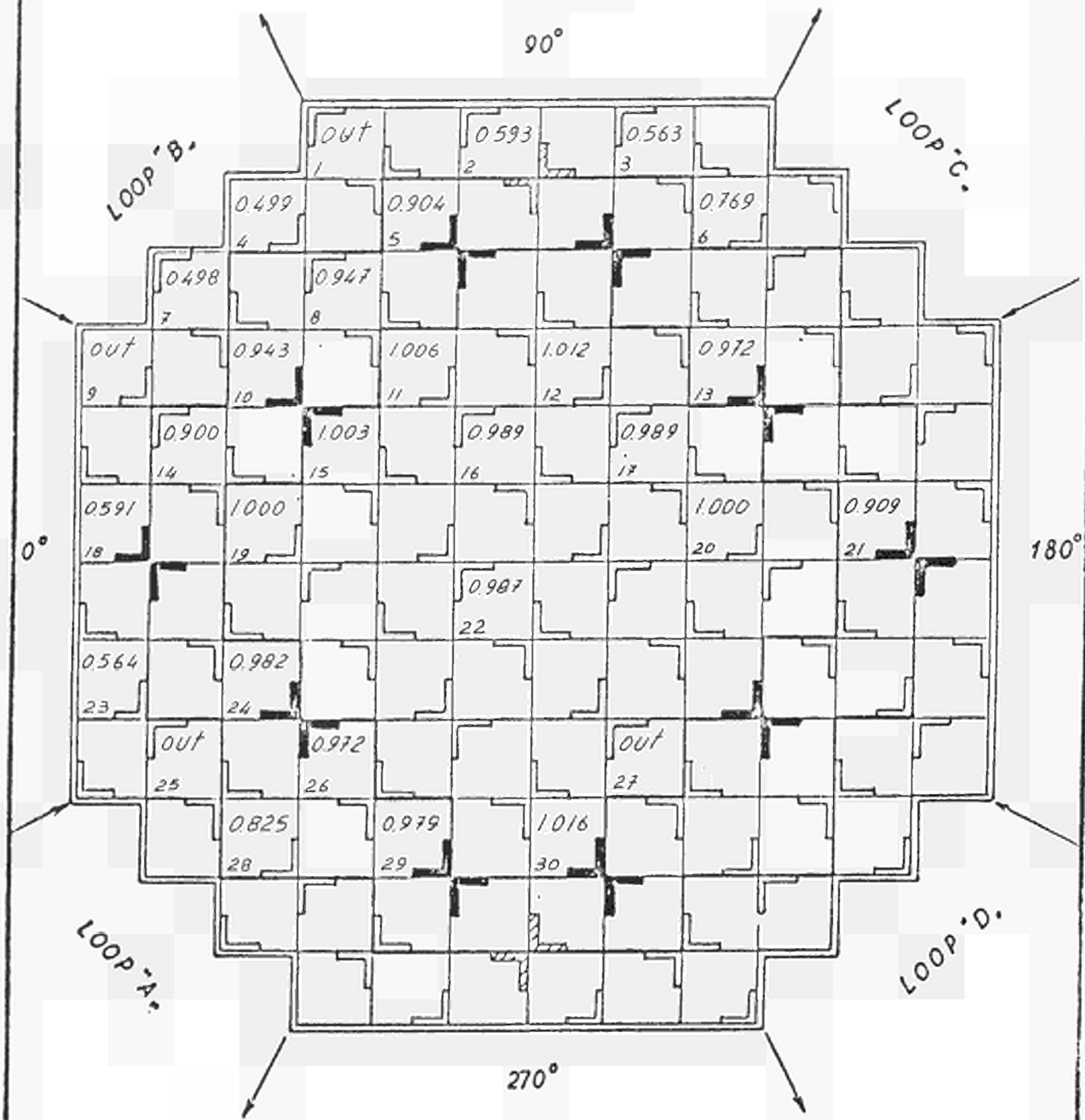
Control Group Position, steps 263

Trim Group Position, steps 286

Irradiation Level, MWD/MTU 4257

ENEL - DCTN	
Date: April - 4 - 1967	
Dftm: P.Z	App: S.V

FIG. 4C RATIO OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL (No 19)



Aeroball Run N° 37B

Data JANUARY 19, 1967

Electrical Power Level, MW 255

Control Group Position, steps 263

Trim Group Position, steps 286

Irradiation Level, MWD/MTU 9769

ENEL - DCTN	
Data: April - 5 - 1967	
Dftm: P.Z.	App: S.V

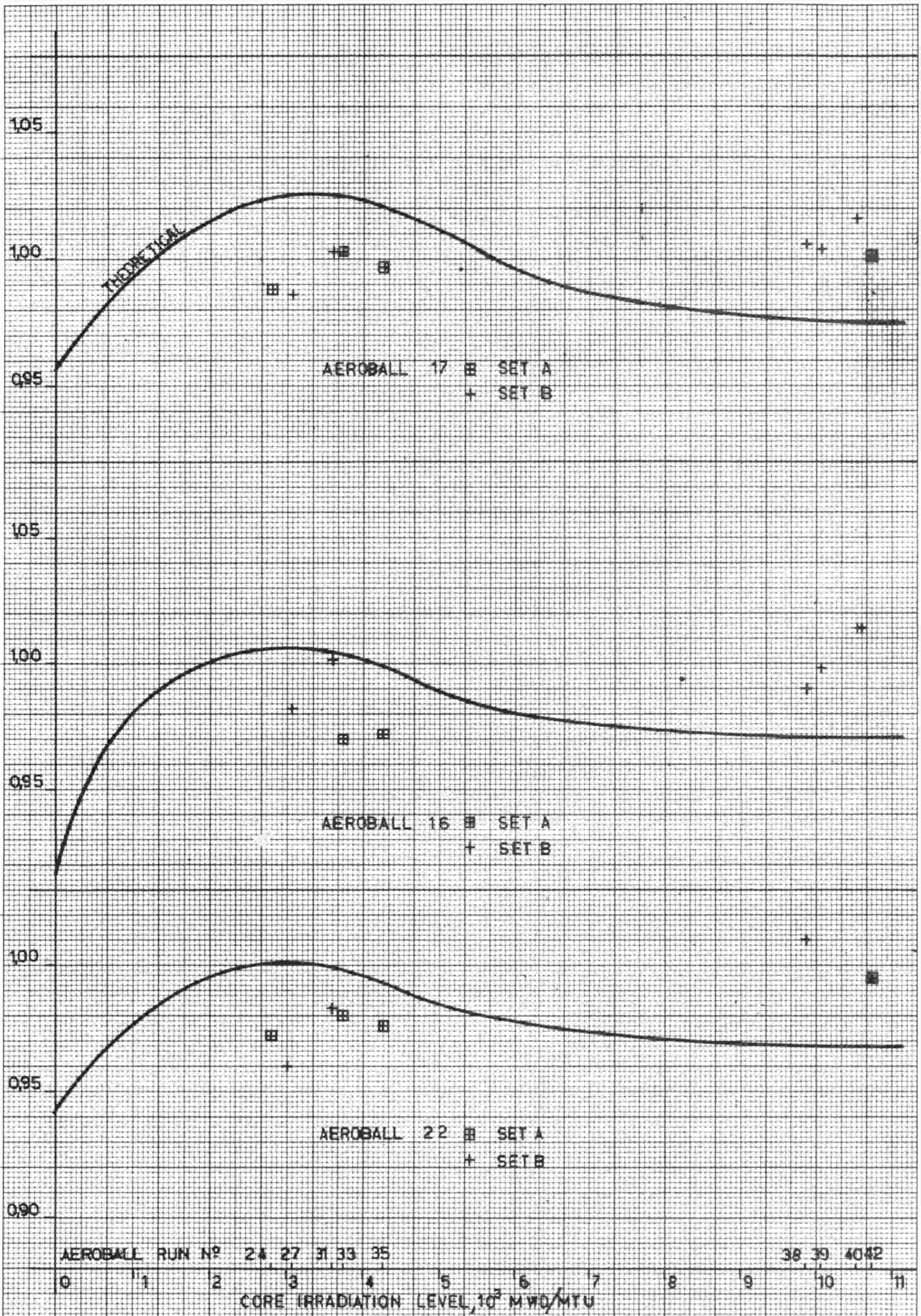


fig. 5 A

RATIOS of AEROBALL ACTIVITIES to ACTIVITY in the REFERENCE AEROBALL vs CORE IRRADIATION LEVEL

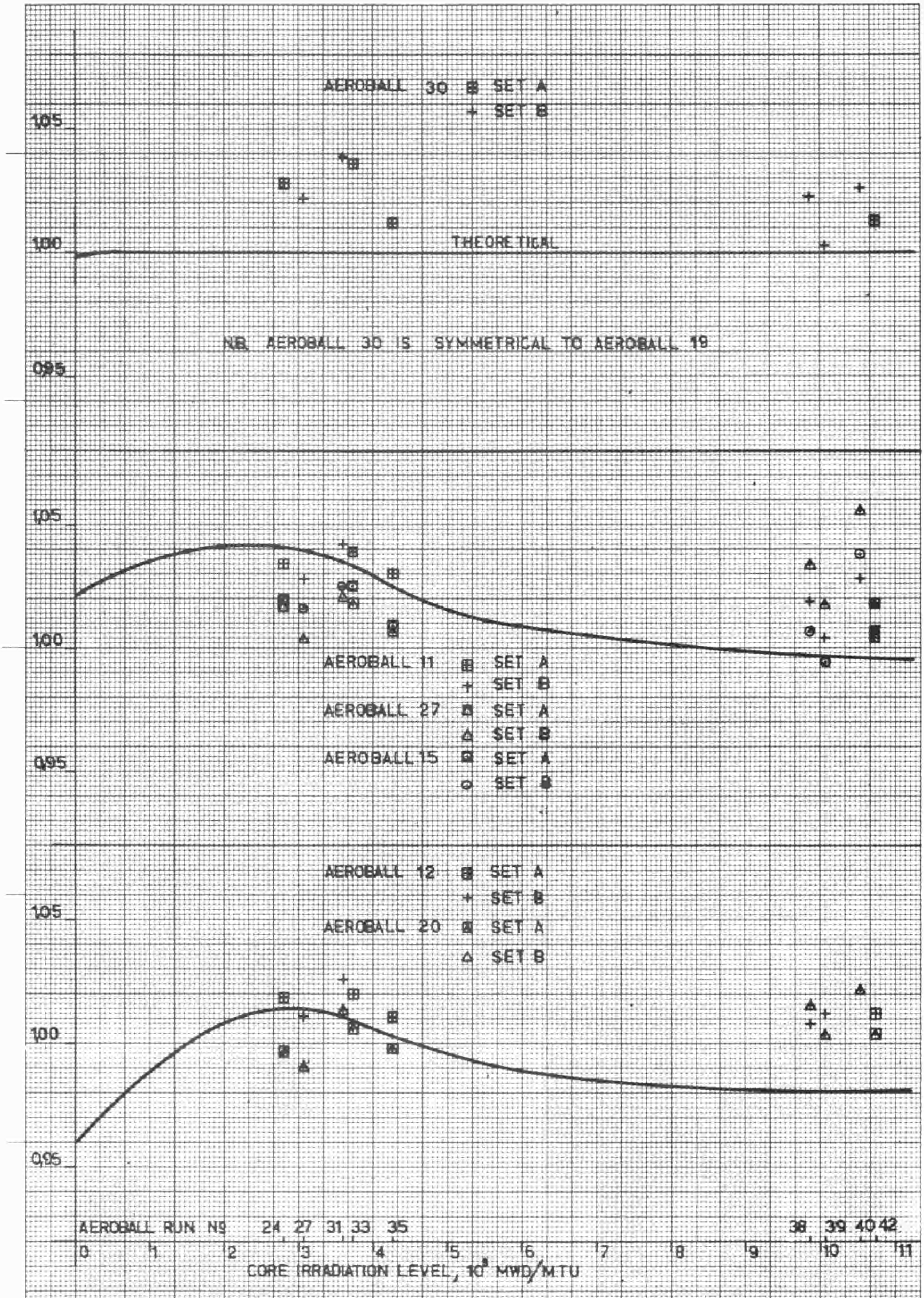


fig. 5 B RATIOS of AEROBALL ACTIVITIES to ACTIVITY in the REFERENCE AEROBALL vs CORE IRRADIATION LEVEL

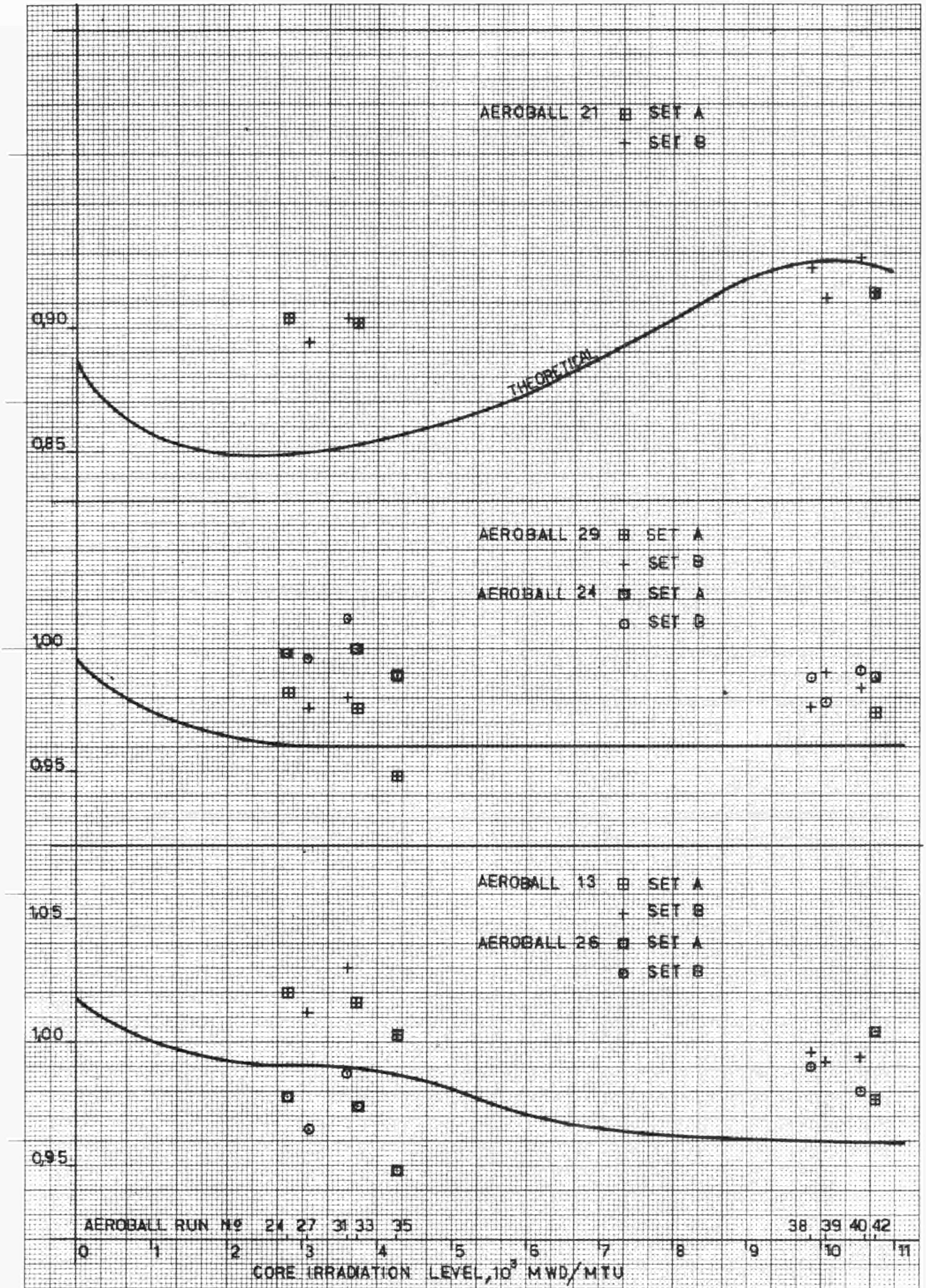


Fig. 5 C RATIOS of AEROBALL ACTIVITIES to ACTIVITY in the REFERENCE AEROBALL vs CORE IRRADIATION LEVEL

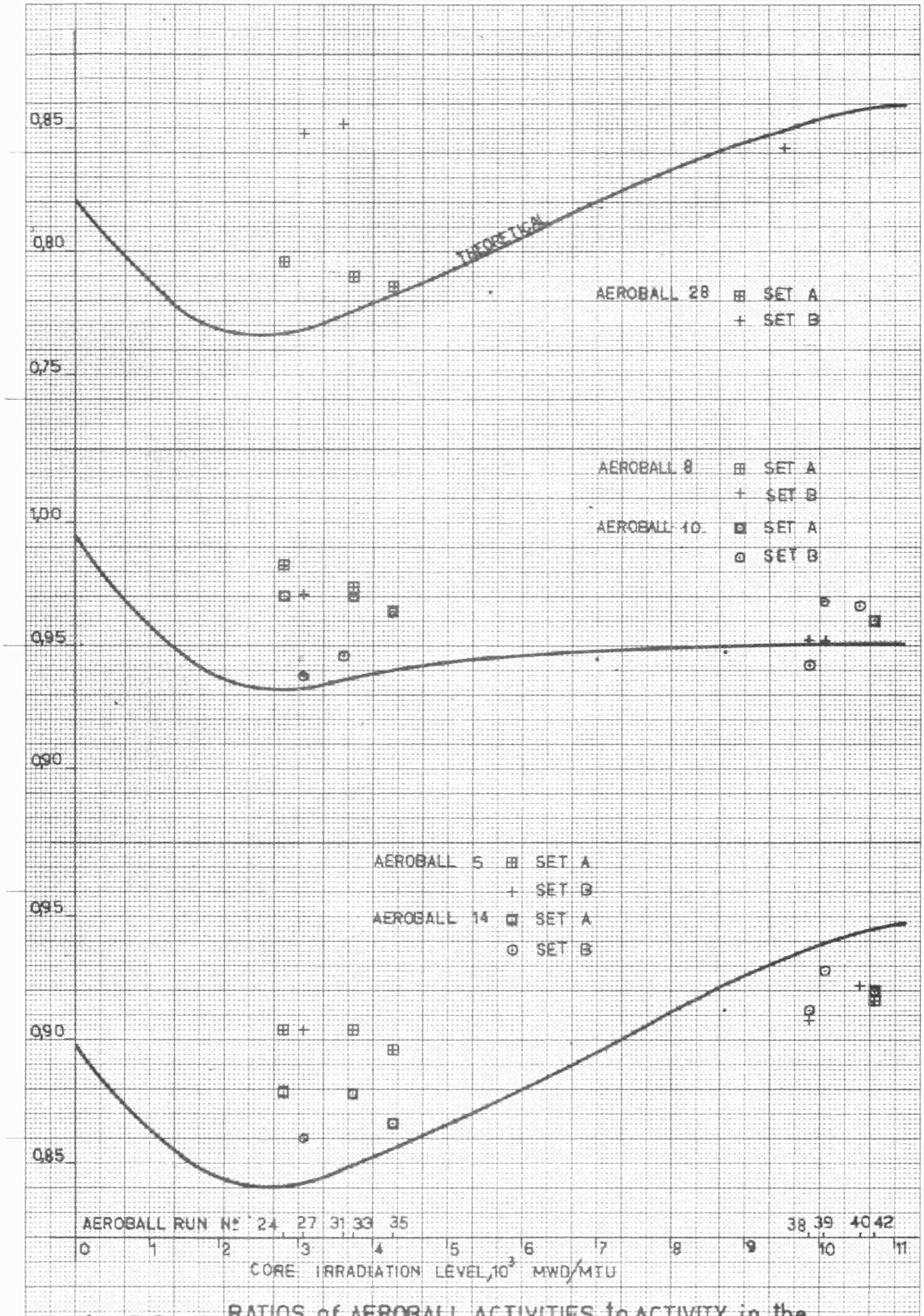


fig. 5 D RATIOS of AEROBALL ACTIVITIES to ACTIVITY in the REFERENCE AEROBALL vs CORE IRRADIATION LEVEL

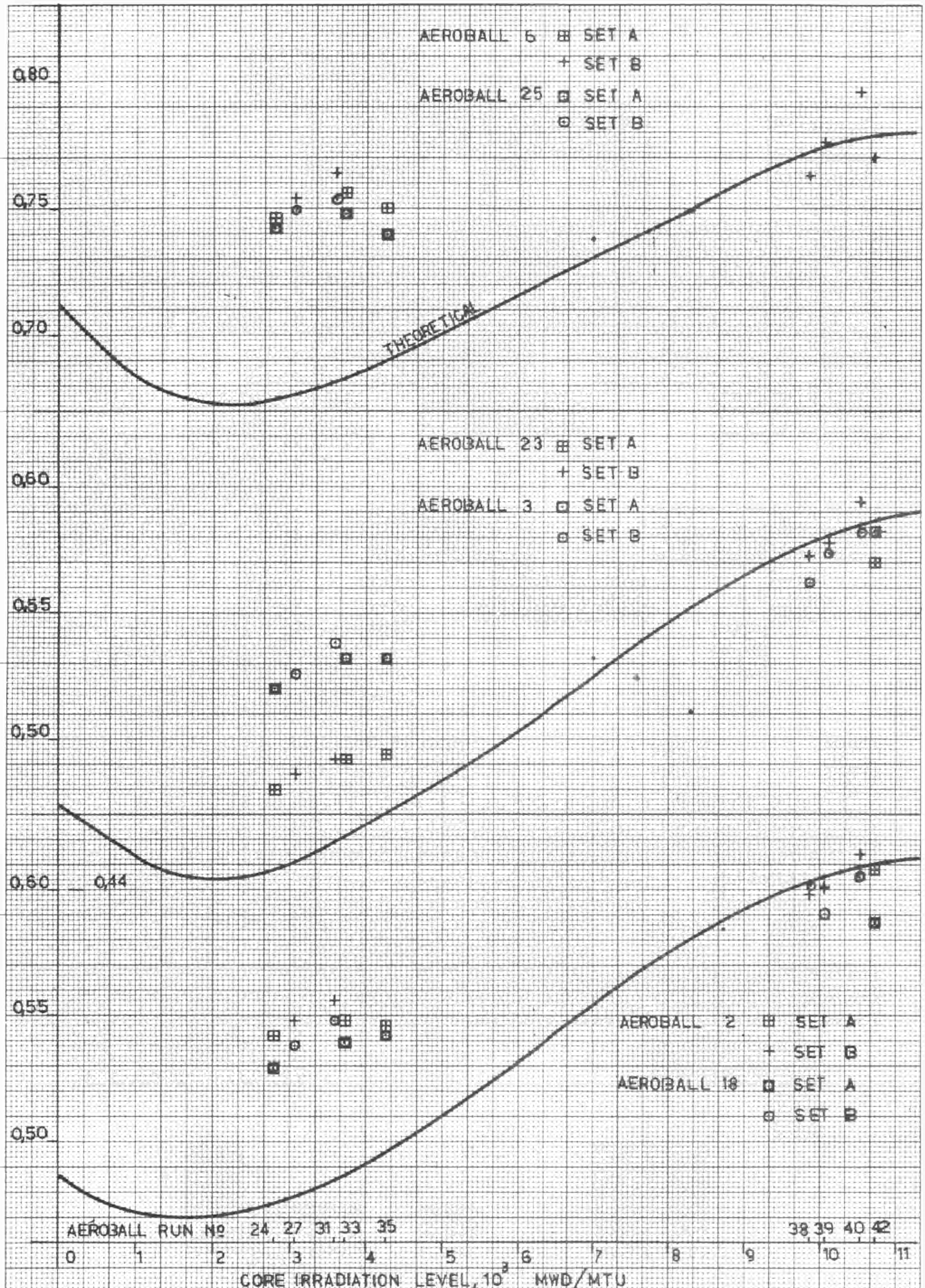


fig. 5 E RATIOS of AEROBALL ACTVITIES to ACTIVITY in the REFERENCE AEROBALL vs CORE IRRADIATION LEVEL

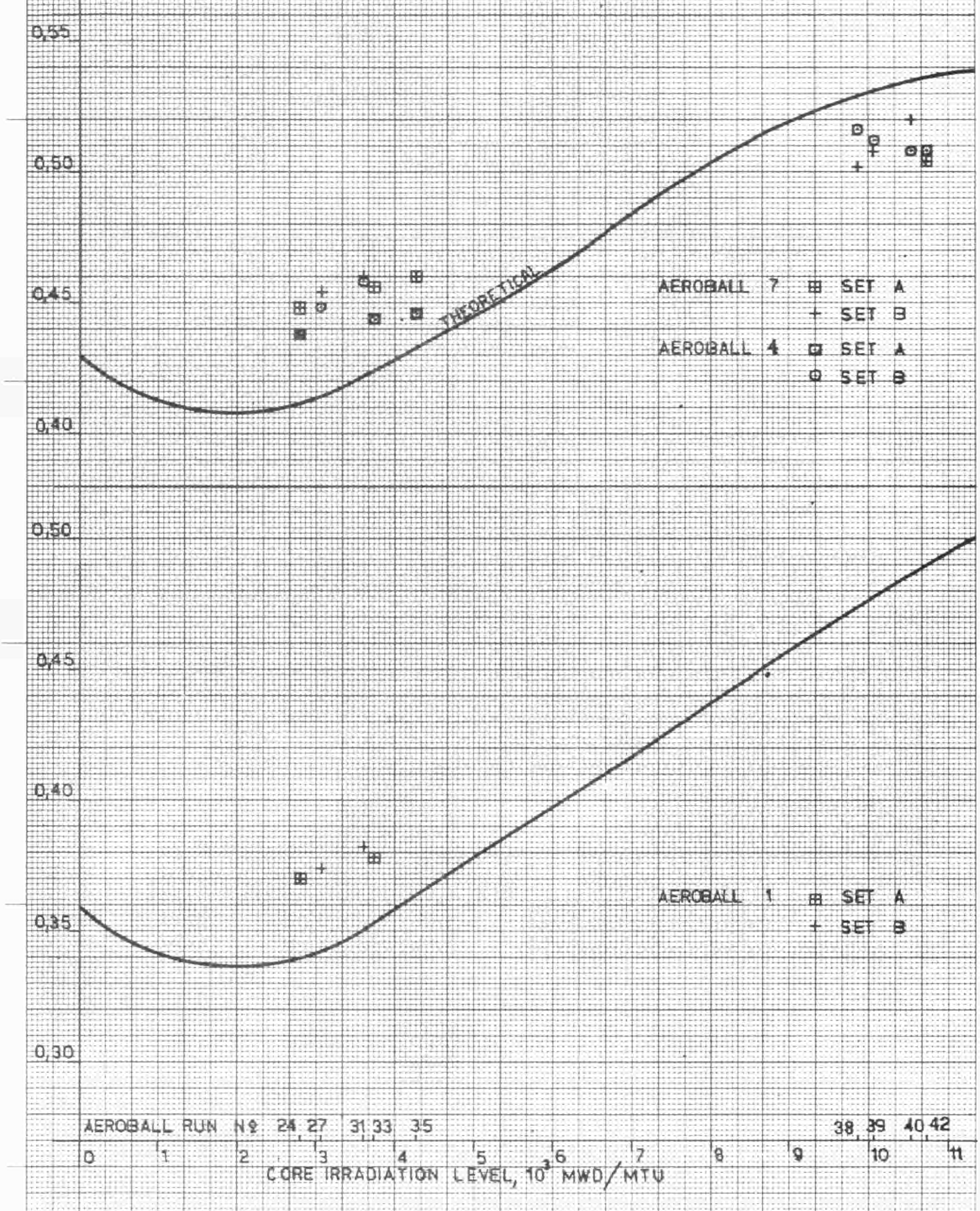
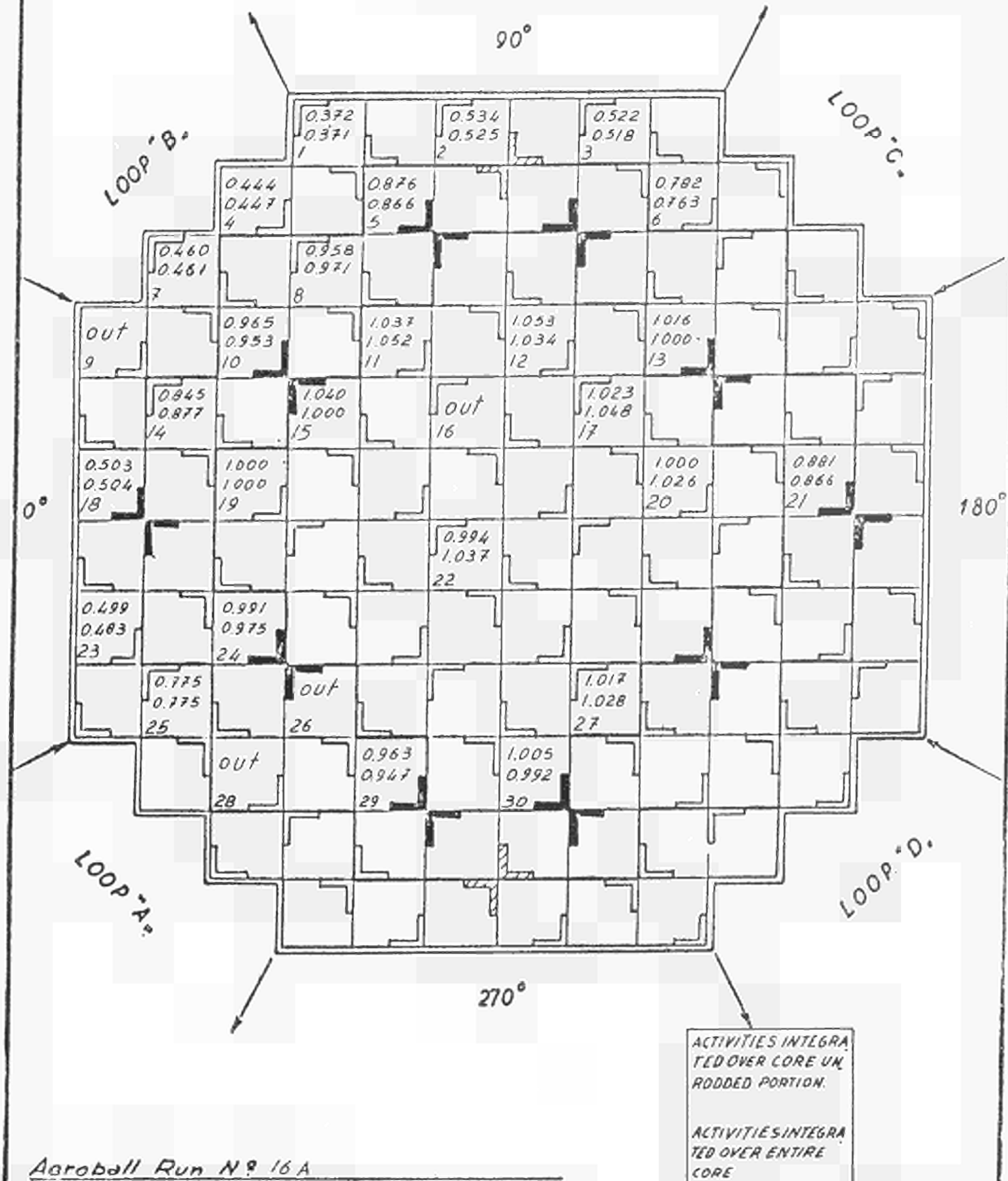


fig. 5 F RATIOS of AEROBALL ACTIVITIES to ACTIVITY in the REFERENCE AEROBALL vs CORE IRRADIATION LEVEL

FIG. 6A RATIO OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL FOR AR'S 16 AND 19 WITH CONTROL GROUP PARTIALLY INSERTED



Aeroball Run N° 16 A

Date OCTOBER 19. 1965

Electrical Power Level, MW 156

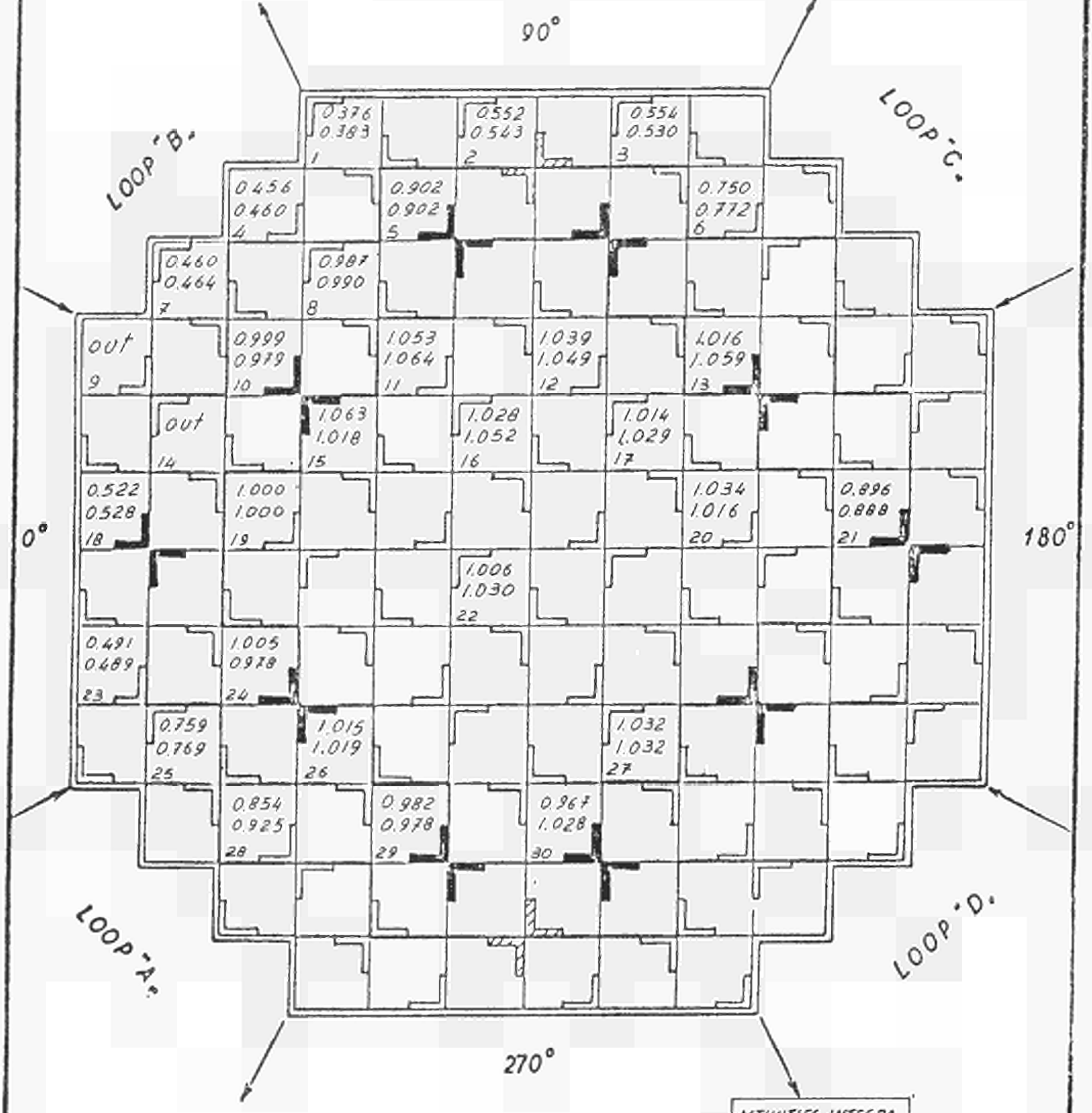
Control Group Position, steps 193

Trim Group Position, steps 286

Irradiation Level, MWD/MTU 2673

ENEL - DCTN	
Date: April - 5 - 1967	
Dftm: P.Z.	App: S.V.

FIG 6.8 RATIO OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL FOR AR'S 16 AND 19 WITH CONTROL GROUP PARTIALLY INSERTED



ACTIVITIES INTEGRATED OVER CORE UNRODDED PORTION

ACTIVITIES INTEGRATED OVER ENTIRE CORE

Aeroball Run N° 19 B

Date OCTOBER 23, 1965

Electrical Power Level, MW 200

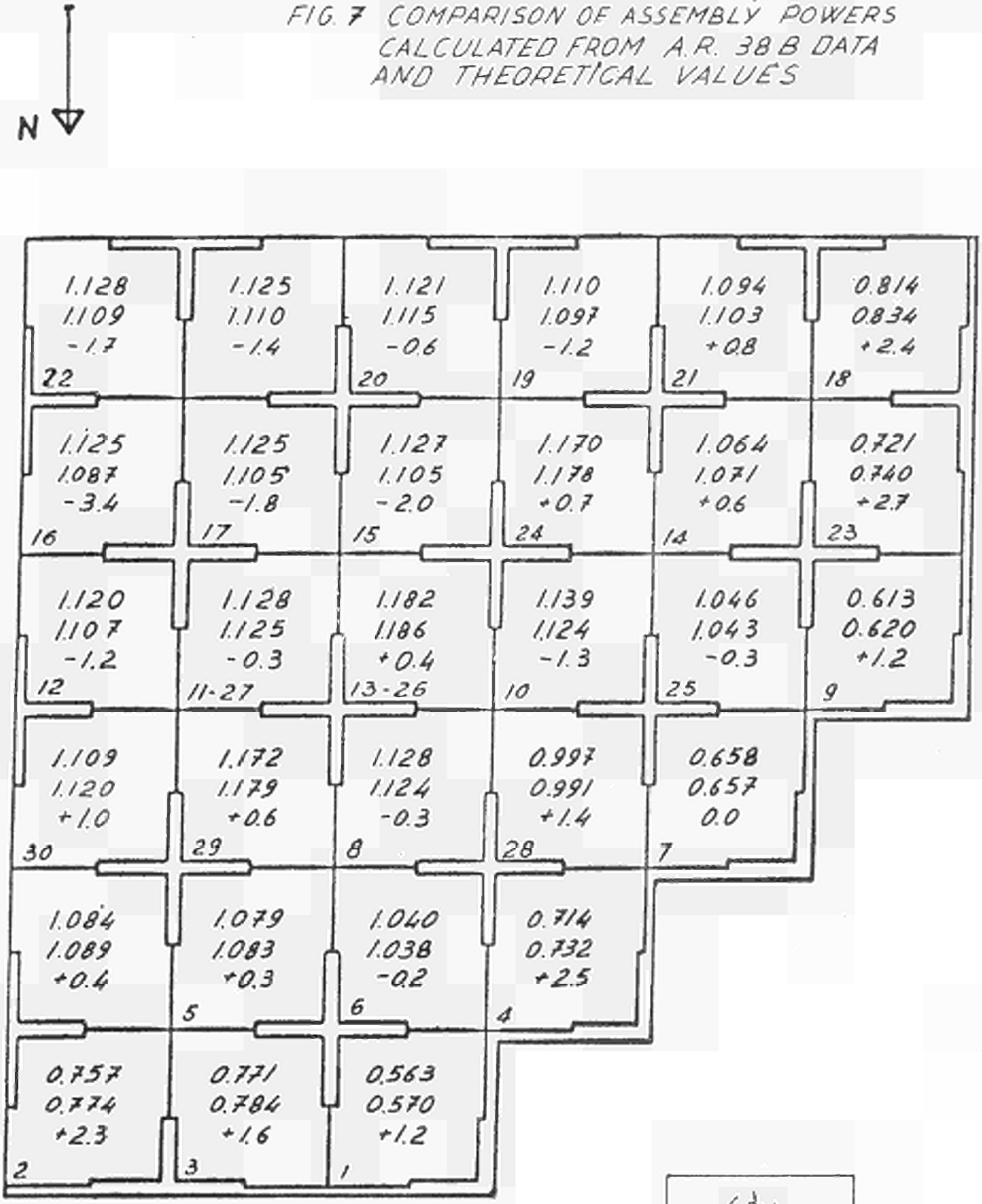
Control Group Position, steps 223

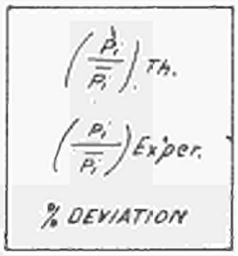
Trim Group Position, steps 286

Irradiation Level, MWD/MTU 2726

ENEL - DCTN	
Date: April - 6 - 1967	
Dftm: P.Z	App: S.V

FIG. 7 COMPARISON OF ASSEMBLY POWERS CALCULATED FROM A.R. 38 B DATA AND THEORETICAL VALUES





Aeroball Run N° 38 B

Date JANUARY 23, 1967

Electrical Power Level, MW 255

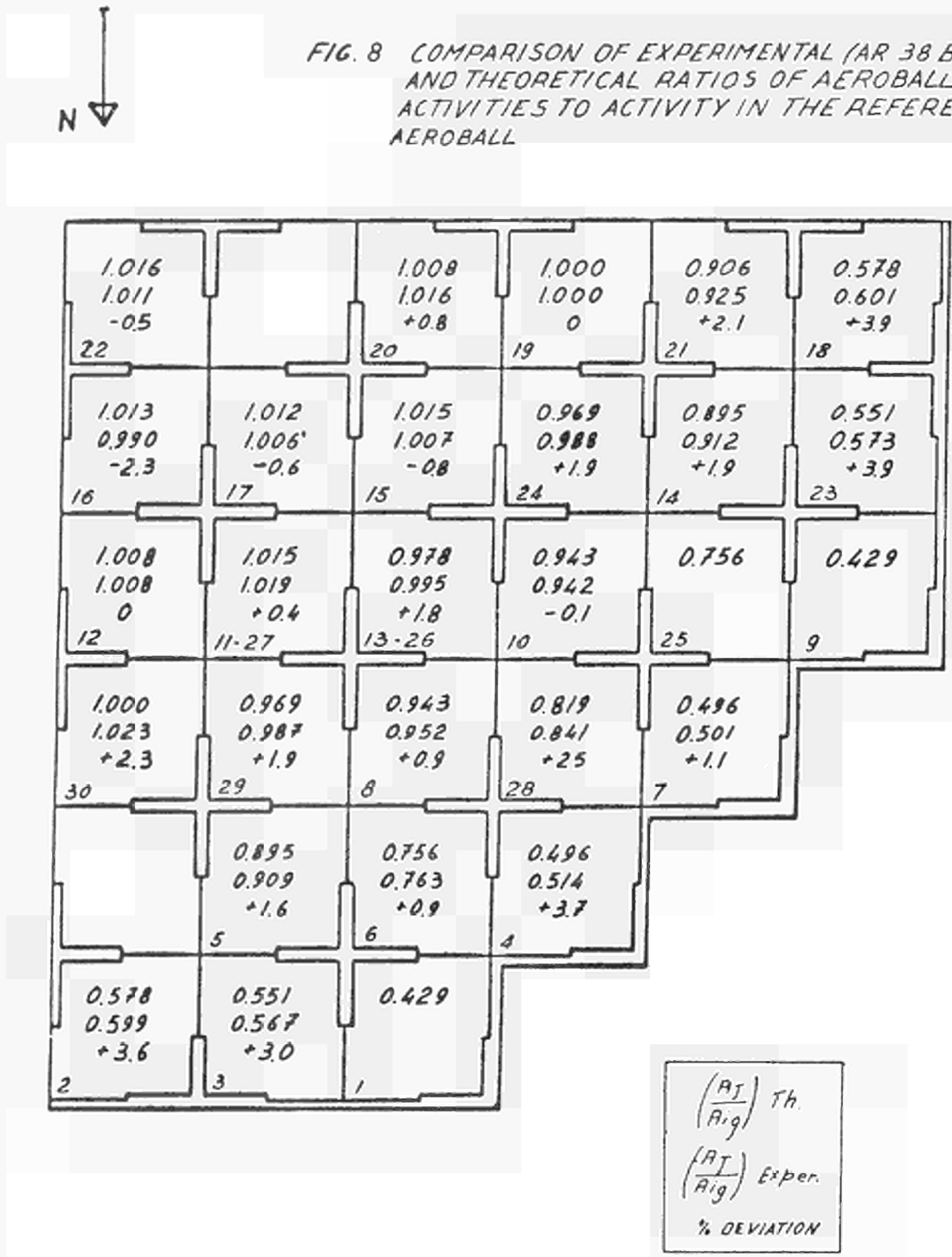
Control Group Position, steps 263

Trim Group Position, steps 286

Irradiation Level, MWD/MTU 9850

ENEL — DCTN	
Date: April - 6 - 1967	
Dftmi P.Z.	Appd S.V.

FIG. 8 COMPARISON OF EXPERIMENTAL (AR 38 B) AND THEORETICAL RATIOS OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL



Aeroball Run Nº 38 B
Date JANUARY 23, 1967
Electrical Power Level, MW 255
Control Group Position, steps 263
Trim Group Position, steps 286
Irradiation Level, MWD/MTU 9850

ENEL – DCTN
Date: March -31- 1967
Dftm: P.Z. App: S.V

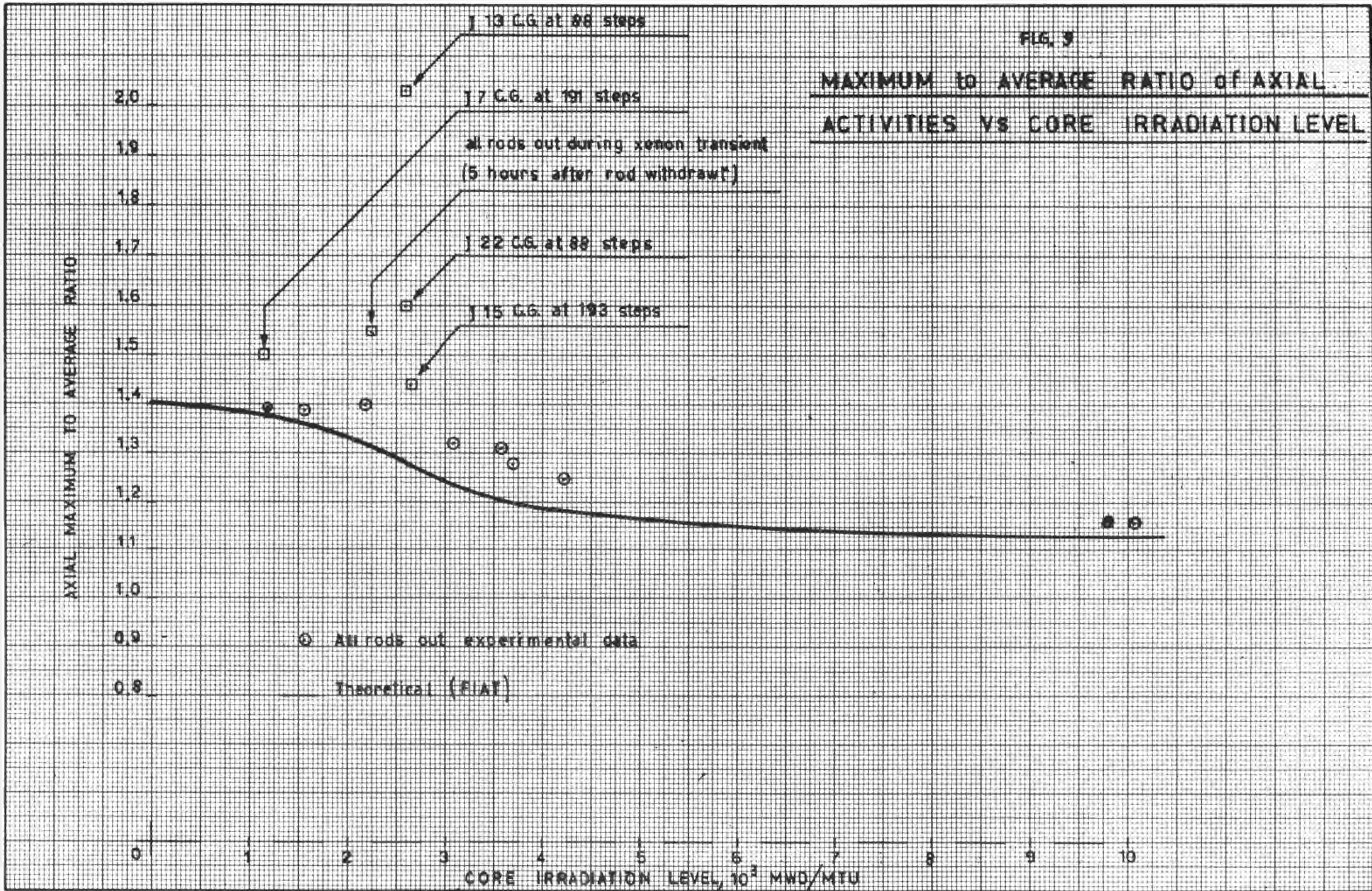
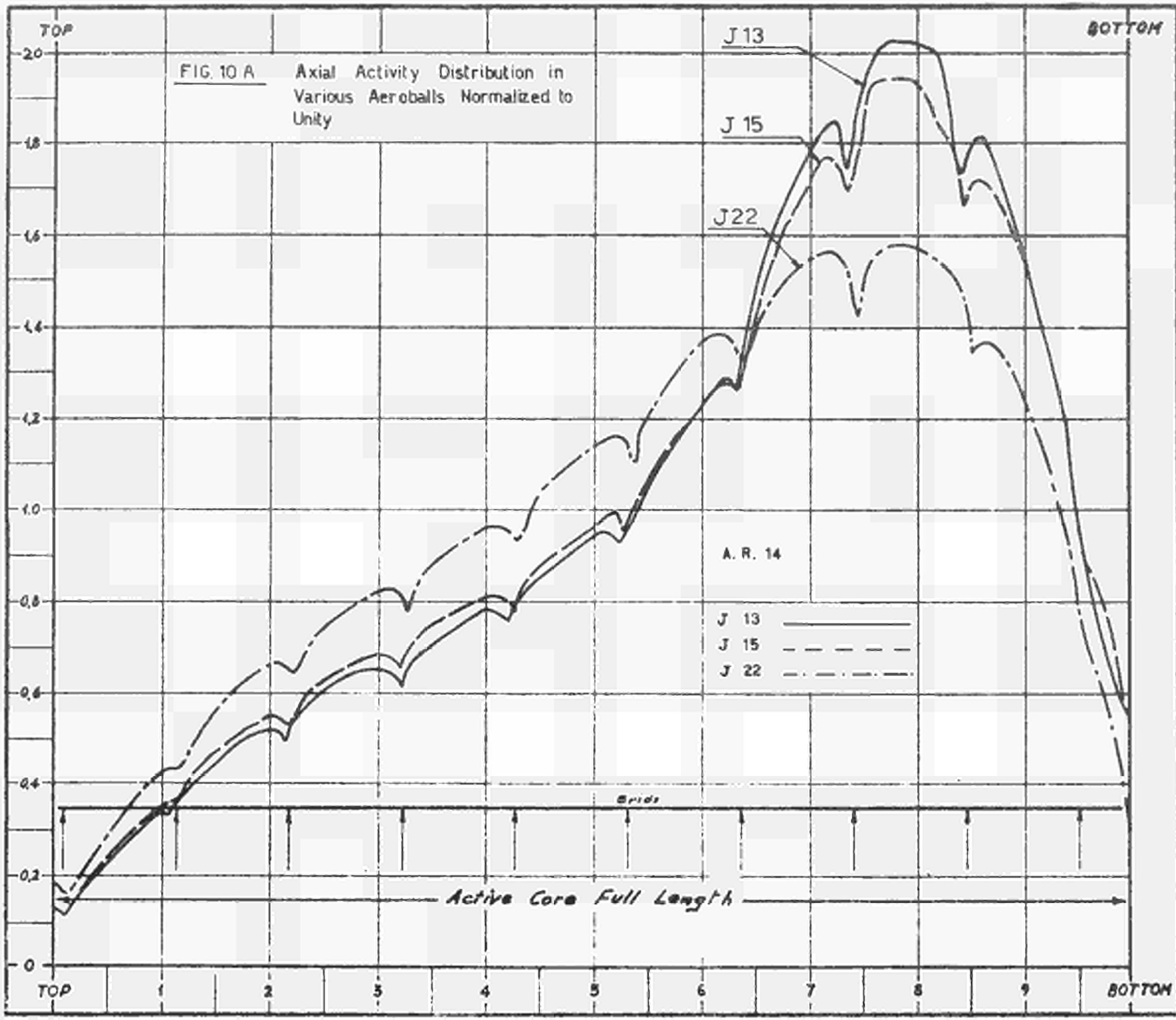


FIG. 9
MAXIMUM to AVERAGE RATIO of AXIAL ACTIVITIES Vs CORE IRRADIATION LEVEL
J 13 C.G. at 88 steps
J 7 C.G. at 191 steps
all rods out during xenon transient (5 hours after rod withdrawl)
J 22 C.G. at 88 steps
J 15 C.G. at 193 steps
AXIAL MAXIMUM TO AVERAGE RATIO
2,0
1,9
1,8
1,7
1,6
1,5
1,4
1,3
1,2
1,1
1,0
0,9
0,8
0
1
2
3
4
5
6
7
8
9
10
All rods out experimental data
Theoretical (FIAT)
CORE IRRADIATION LEVEL, 10³ MWD/MTU



Notes

A. R. 14, set B

Irradiation level : 2600 MWd/MTU

Control group position : 88 steps

Electrical Power : 45 MWe

ENEL - DCTN

Date : April- 6 -1967

Dftm. : F S

App. : G B

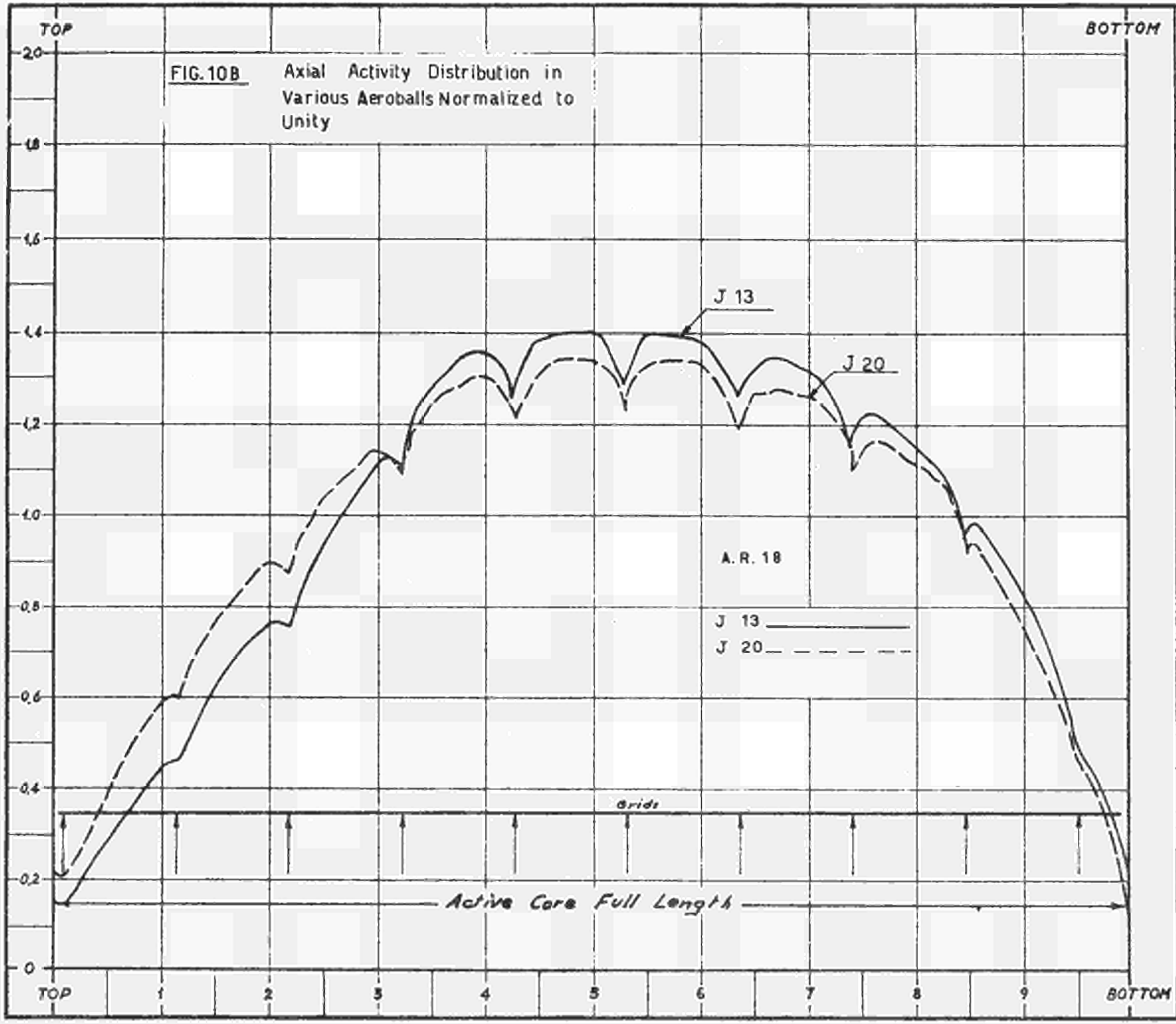


FIG. 10B Axial Activity Distribution in Various Aeroballs Normalized to Unity

Notes

A. R. 18, set A

Irradiation level: 2686 MWd/MTU

Control group position: 199 steps

Electrical Power: 156 MWe

ENEL - DCTN

Date : April - 6 - 1967

Dftm.: F S

App.: G 8

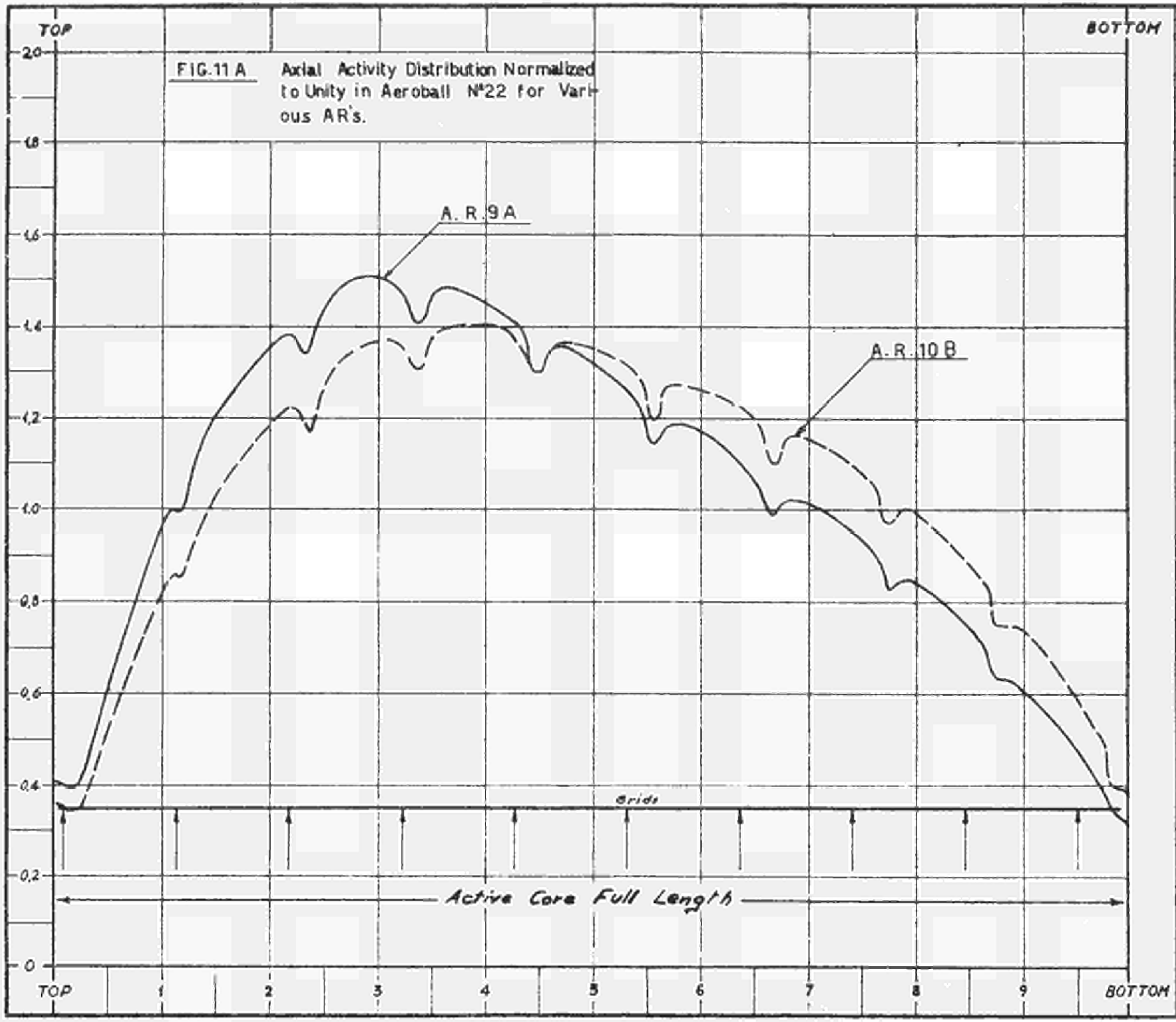


FIG. 11 A Axial Activity Distribution Normalized to Unity in Aeroball N°22 for Various AR's.

Notes

Aeroball N°22

A.R.	MWD / MTU	MWe	C.G. Steps
9	2220	126	286
10	2250	126	286

A.R. 9, was performed 5 hours since complete rod with drawal;

A.R. 10, after additional 44 hours.

ENEL - DCTN

Date : April - 7 - 1967

Dftm. : F S

App. : G B

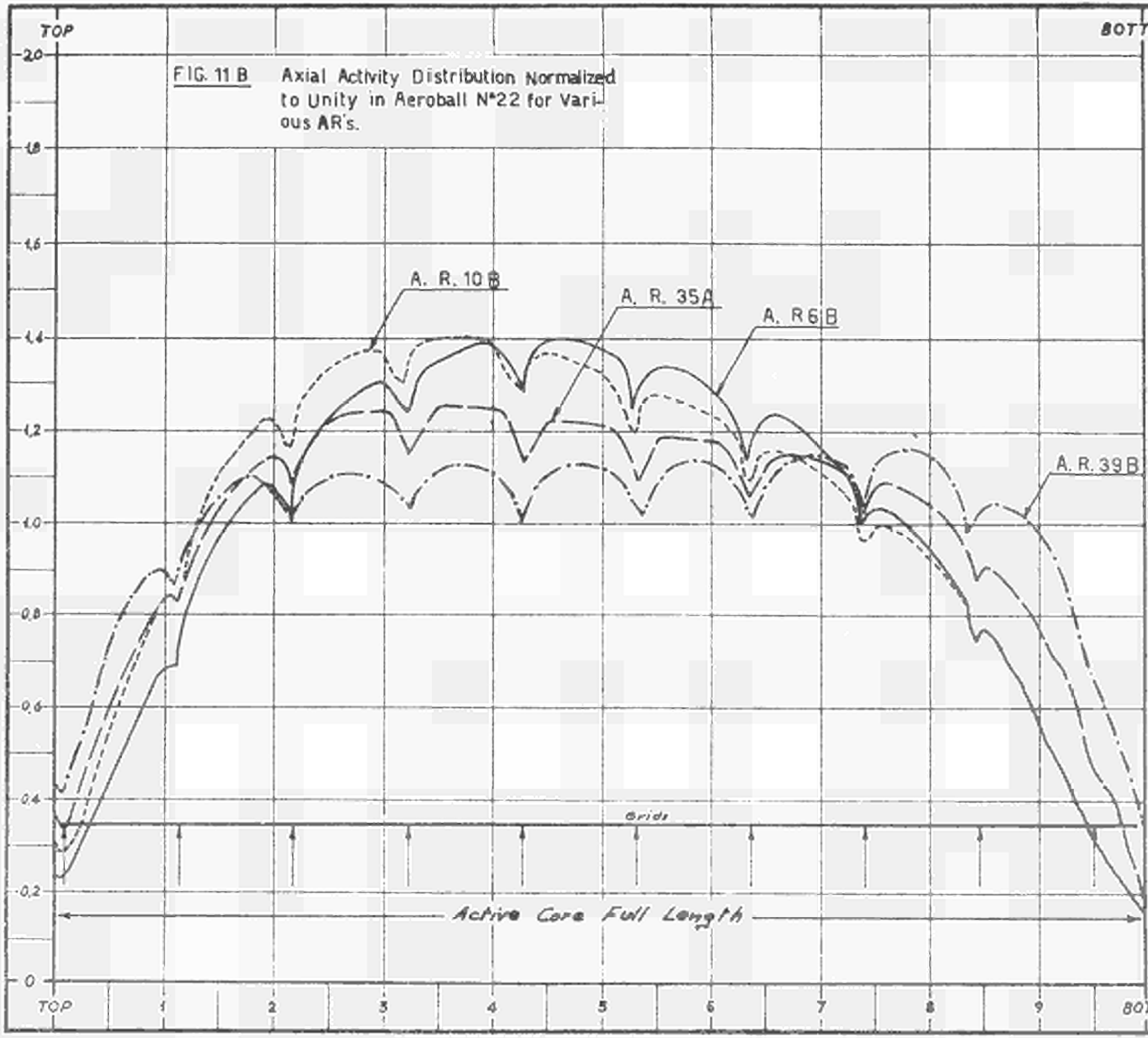


FIG. 11 B Axial Activity Distribution Normalized to Unity in Aeroball N°22 for Various AR's.

Notes

Aeroball N° 22

A. R.	MWD / MTU	MWe	C.G. Steps
6	1580	182	280
10	2250	126	286
35	4257	255	263
39	10.038	255	263

ENEL – DCTN

Date : April – 7 – 1967

Dftm. : F S | App. : G B

ENEL	TABLE 1a – SUMMARY OF AEROBALL RUNS							Date: March - 1 - 1967 Comp.: GB App.: SV	
A. R.	Date	Starting Time for Irradiation	Irradiation Time	Aeroballs not Working	Electrical Power History during last 3 Days	Irradiation Level	Control Group Position	Boron Concentration	Notes
			minutes		MW(e)	MWD/MTU	steps	ppm	
1	2. 12. 65	10. 04	2	9 - 22	constant at 190	990	190		T. G. 152 steps
2 A	2. 24. 65	06. 29	2	9 - 16 - 22	constant at 180	1170	280	1417	T. G. 280 steps
3 B	3. 6. 65	00. 50	10	9 - 22 - 27	constant at zero (5 MWt)	1170	191	1638	T. G. 271 steps
4 A	3. 25. 65	08. 53	10	9-16-23-26-27	constant at 184	1420	209	1256	T. G. 136 steps
4 B	3. 25. 65	09. 50	10	9-16-26-27	constant at 184	1420	209	1256	T. G. 136 steps
5 A	4. 2. 65	09. 19	10	9-16-26-27	constant at 182	1520	181	1208	T. G. 148 steps
5 B	4. 2. 65	10. 19	10	9 - 26 -27	constant at 182	1520	181	1208	T. G. 148 steps
6 A	4. 6. 65	17. 32	10	9-16-26-27	constant at 182	1580	280	1296	T. G. 280 steps
6 B	4. 6. 65	19. 08	10	9 - 26 - 27	constant at 182	1580	280	1296	T. G. 280 steps
7 A	4. 7. 65	16. 30	10	9 - 26 - 27	constant at 180	1600	280	1290	for this and subsequent runs: T. G. 286
8 A	4. 9. 65	11. 20	10	9 - 26 - 27	constant at 180	1620	188	1200	
8 B	4. 9. 65	11. 50	10	9 - 26 - 27	constant at 180	1620	188	1200	
9 A	6. 2. 65	12. 20	10	9 - 3 - 16	142 until 6 pm on June 1st 126 during A. R.	2220	286	1285	
10 B	6. 4. 65	07. 50	10	9 - 27	constant at 126	2250	286	1279	

ENEL

TABLE 1b – SUMMARY OF AEROBALL RUNS

Date: March-2-1967
Comp.: GB
App.: SV

A. R.	Date	Starting Time for Irradiation	Irradiation Time	Aeroballs not Working	Electrical Power History during last 3 Days	Irradiation Level	Control Group Position	Boron Concentration	Notes
			minutes		MW(e)	MWD/MTU	steps	ppm	
11 A	7.24.65	17.15	10	9	zero until 1am on July 24th 24 during A. R.	2260	181	1433	
12 B	9. 1. 65	08.21	10	5-9-11-16 25-26-27-28	constant at 70	2280	188	1260	
13 A	9.27.65	14.59	10	9 - 16	184 until 8 pm on Sep. 26th 52 at measure	2520	156	1160	
13 B	9.27.65	17.00	10	9-25-26-27	184 until 8 pm on Sep. 26th 52 at measure	2520	182	1225	
14 B	10.1.65	16.30	15	9 - 5 - 26	constant at 45	2600	88		
15 A	10.15.65	10.15	10	9	constant at 158	2610	229	1171	
15 B	10.19.65	08.55	1	9-5-14-26	constant at 158	2660	192	1136	
16 A	10.19.65	21.33	10	9-16-26-28	constant at 156	2673	193	1136	
17 B	10.20.65	13.25	10	9 - 14	155 until 1 pm on Oct. 20th 103 at measure	2683	179	1138	
18 A	10.20.65	18.22	10	9 - 16 - 28	103 until 5 pm on Oct. 22th 156 at measure	2686	199	1138	
19 B	10.23.65	18.01	19	9 - 14	184 until 5 pm on Oct. 23th 200 at measure	2726	223	1132	
20 A	10.24.65	18.18	10	9 - 16 - 28	constant at 200	2741	232	1123	Rod 33 stuck at 221 steps
21 B	10.24.65	18.43	20	9 - 14	constant at 200	2471	238	1117	
22 A	10.26.65	17.38	10	9	200 until 12 pm on Oct. 24th 215 at measure	2272	252	1117	

ENEL	TABLE 1c – SUMMARY OF AEROBALL RUNS	Date: March-3-1967 Comp.: SV App.: GB

A. R.	Date	Starting Time for Irradiation	Irradiation Time	Aeroballs not Working	Electrical Power History during last 3 Days	Irradiation Level	Control Group Position	Boron Concentration	Notes
			minutes		MW(e)	MWD/MTU	steps	ppm	
23 B	10. 26. 65	19. 11	20	9	constant at 220	2273	265	1112	
24 A	10. 28. 65	16. 54	10	9 - 16	constant at 220	2803	265	1112	
25 B	11. 10. 65	14. 05	10	9	constant at 225	3041	259	1078	
26 A	11. 17. 65	14. 22	15	9 - 16	constant at 225	3060	259	1078	
27 B	11. 18. 65	01. 41	10	9	constant at 225	3069	259	1076	
28 A	11. 19. 65	19. 45	10	9 - 16	constant at 220	3102	259	1128	
29 A	12. 9. 65	16. 20	10	9 - 8	255 until 6 pm on Dec. 6th 190 at measure	3492	251	1063	
30 B	12. 9. 65	20. 05	10	9	190 until 5 pm on Dec. 9th 255 at measure	3495	250	1063	
31 B	12. 14. 65	16. 34	10	9	constant at 255	3597	263	1000	
32 B	12. 16. 65	15. 54	10	9	constant at 255	3638	263	999	
33 A	12. 17. 65	15. 50	10	9 - 8	constant at 255	3743	263	967	
34 B	1. 10. 66	09. 27	10	9	188 until 8 pm on Jan. 9th 255 at measure	4043	260	984	
35 A	1. 20. 66	13. 18	10	9 - 8	constant at 255	4257	263	913	
36 B	7. 12. 66	09. 15	10	1-2-3-7-10-12-13-23-24-25-27-28-9	constant at 95	6345	255	840	

ENEL	TABLE 1d-SUMMARY OF AEROBALL RUNS	Date: March-4-1967 / Comp.: SV / App.: GB

A. R.	Date	Time-in	Irradiation Time	Channels out	Electrical Power History during last 3 Days	Irradiation Level	Control Group Position	Boron Concentration	Notes
			minutes		MW(e)	MWD/MTU	steps	ppm	
37 B	1.19.67	14.24	10	1-9-25-27	constant at 255	9769	263	180	
38 B	1.23.67	11.40	20	1 - 9 - 25	constant at 255	9850	263	170	
39 B	2. 1.67	13.30	20	1-5-9-22-25-26-28	constant at 255	10038	263	146	
39 A	2. 1.67	13.56	1	1-5-9-16-25	constant at 255	10038	263	146	
40 B	2.27.67	10.15	5	1-8-9-14-22-25-28	constant at 255	10557	263	83	
41 A	2.27.67	14.09	20	1-8-9-16-25-28	constant at 255	10557	263	83	
42 A	3. 9.67	10.56	10	1-8-9-16-25-28	constant at 255	10763	263	60	
43 B	3.9.67	20.22	10	1-8-9-16-22-25-28	constant at 255	10771	263	133	core water Tavg : 261 °C
44 A	3.14.67	11.45	20	1 - 9 - 25	constant at 255	10869	286	54	
45 B	16.3.67	09.50	20	1 - 9 - 25	constant at 255	10909	286	53	
46 A	16.3.67	16.40	20	1 - 9 - 25	constant at 255	10915	220	53	core water Tavg : 265 °C
47 B	17.3.67	20.25	20	1 - 9 - 25	constant at 255	10938	220	53	core water Tavg : 263 °C

ENEL	Table 2a A.R. 16 A $S/S_{16} = 1$ 2673 MWD/MTU
Data: 6 - 3 - 1967	Integrated Aeroball Activities and Ratios of Integrated Activities to Activity in the Reference Aeroball (No 19)
Calcolato: AL / Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$	C_J	$I_{Jc} = \frac{I_J}{C_J}$	$\frac{I_{Jc}}{\frac{S}{S_{16}}}$ MW(t)	$\frac{I_{Jc}}{I_{19c}}$
1	0,3354	0,997	0,3364	68,2	0,371
2	0,4821	1,013	0,4759	96,5	0,525
3	0,4689	0,999	0,4694	95,2	0,518
4	0,4072	1,006	0,4048	82,1	0,447
5	0,7987	1,018	0,7846	159,1	0,866
6	0,6938	1,004	0,6910	140,2	0,763
7	0,4225	1,011	0,4179	84,8	0,461
8	0,9107	1,036	0,8790	178,3	0,971
10	0,8597	0,996	0,8631	175,1	0,953
11	0,9756	1,024	0,9527	193,2	1,052
12	0,9717	1,038	0,9361	189,9	1,034
13	0,9298	1,027	0,9053	183,6	1,000
14	0,8259	1,040	0,7941	161,1	0,877
15	0,9350	1,032	0,9060	183,8	1,000
16	out	—	—	—	—
17	0,9679	1,020	0,9489	192,5	1,048
18	0,4635	1,015	0,4566	92,6	0,504
19	0,9446	1,043	0,9056	183,7	1,000
20	0,9565	1,029	0,9295	188,5	1,026
21	0,8168	1,042	0,7839	159,0	0,866
22	0,9804	1,044	0,9391	190,5	1,037
23	0,4377	1,001	0,4373	88,7	0,483
24	0,9017	1,021	0,8831	179,1	0,975
25	0,6890	1,008	0,6835	138,6	0,755
26	out	—	—	—	—
27	0,9598	1,031	0,9309	188,8	1,028
28	out	—	—	—	—
29	0,8878	1,035	0,8578	174,0	0,947
30	0,9212	1,025	0,8987	182,3	0,992

ENEL	Table 2 b A.R. # 19 B S/S_{16} = – 2726 MWD/MTU
Data: 6 - 3 - 1967	Integrated Aeroball Activities and Ratios of Integrated Activities to Activity in the Reference Aeroball (No 19)
Calcolato: OB — Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$	C_J	$I_{Jc} = \frac{I_J}{C_J}$	$\frac{I_{Jc}}{\frac{S}{S_{16}} MW(t)}$	$\frac{I_{Jc}}{I_{19c}}$
1	0,4804	1,015	0,4733	—	0,383
2	0,6881	1,026	0,6707	—	0,543
3	0,6656	1,017	0,6545	—	0,530
4	0,5798	1,021	0,5679	—	0,460
5	1,1464	1,029	1,1141	—	0,902
6	0,9727	1,020	0,954	—	0,772
7	0,5870	1,025	0,573	—	0,464
8	1,2866	1,048	1,2281	—	0,990
10	1,2087	1,000	1,2087	—	0,979
11	1,3591	1,033	1,3150	—	1,064
12	1,3591	1,033	1,2962	—	1,049
13	1,3534	1,035	1,3076	—	1,059
14	out	—	—	—	—
15	1,3057	1,038	1,2579	—	1,018
16	1,3610	1,047	1,3000	—	1,052
17	1,3086	1,030	1,2705	—	1,029
18	0,6704	1,027	0,6528	—	0,528
19	1,2895	1,044	1,2351	—	1,000
20	1,3000	1,036	1,2548	—	1,016
21	1,1435	1,043	1,0963	—	0,888
22	1,3305	1,046	1,2720	—	1,030
23	0,6151	1,018	0,6042	—	0,489
24	1,2752	1,031	1,2077	—	0,978
25	0,9703	1,022	0,9494	—	0,769
26	1,3152	1,045	1,2585	—	1,019
27	1,3381	1,041	1,2753	—	1,032
28	1,1846	1,037	1,1423	—	0,925
29	1,2570	1,040	1,2086	—	0,978
30	1,3133	1,034	1,2701	—	1,028

ENEL	Table 2c A.R. ≠ 24 A S/S_{16} = 1.037 2803 MWD/MTU
Data: 6-3-1967	Integrated Aeroball Activities and Ratios of Integrated Activities to Activity in the Reference Aeroball (No 19)
Calcolato: AL — Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$	C_J	$I_{Jc} = \frac{I_J}{C_J}$	$\frac{I_{Jc}}{\frac{S}{S_{16}}}$ MW(t)	$\frac{I_{Jc}}{I_{19c}}$
1	0,5297	1,006	0,5265	69,6	0,371
2	0,7910	1,026	0,7709	101,9	0,543
3	0,7476	1,011	0,7395	97,8	0,521
4	0,6346	1,020	0,6221	82,8	0,438
5	1,3209	1,029	1,2837	169,7	0,904
6	1,0825	1,017	1,0644	140,7	0,745
7	0,6513	1,024	0,6360	84,1	0,448
8	1,4459	1,036	1,3956	184,1	0,983
10	1,3763	1,000	1,3763	181,9	0,970
11	1,5146	1,033	1,4662	193,8	1,033
12	1,4974	1,036	1,4453	191,0	1,018
13	1,4964	1,035	1,4458	191,1	1,019
14	1,2933	1,037	1,2471	164,8	0,879
15	1,4984	1,036	1,4463	191,2	1,019
16	out	—	—	—	—
17	1,4478	1,0031	1,4042	185,6	0,988
18	0,7720	1,028	0,7509	99,2	0,529
19	1,4717	1,037	1,4192	187,6	1,000
20	1,4640	1,035	1,4145	186,9	0,997
21	1,3086	1,021	1,2817	169,4	0,903
22	1,4306	1,036	1,3809	182,5	0,973
23	0,6933	1,015	0,6830	90,3	0,481
24	1,4612	1,032	1,4159	187,1	0,998
25	1,0768	1,022	1,0536	139,3	0,742
26	1,4392	1,037	1,3878	183,4	0,978
27	1,4955	1,036	1,4435	190,8	1,017
28	1,1693	1,035	1,1297	149,3	0,796
29	1,4440	1,036	1,3938	184,2	0,982
30	1,5117	1,036	1,4592	192,9	1,028

ENEL	Table 2d A.R. # 27B $S/S_{16} = 1{,}156$ 3069 MWD/MTU
Data: 7-3-1967	Integrated Aeroball Activities and Ratios of Integrated Activities to Activity in the Reference Aeroball (No 19)
Calcolato: AL — Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$	C_J	$I_{JC} = \frac{I_J}{C_J}$	$\frac{I_{JC}}{\frac{S}{S_{16}} MW(t)}$	$\frac{I_{JC}}{I_{19C}}$
1	0,6094	1,001	0,6088	71,4	0,375
2	0,8955	1,009	0,8875	104,1	0,547
3	0,8578	1,003	0,8552	100,3	0,527
4	0,7324	1,006	0,7280	85,4	0,449
5	1,4821	1,010	1,4674	172,2	0,904
6	1,2303	1,006	1,2230	143,5	0,754
7	0,7443	1,009	0,7377	86,5	0,455
8	1,6023	1,007	1,5912	186,7	0,981
10	1,5317	1,006	1,5226	178,6	0,938
11	1,6882	1,011	1,6698	195,9	1,029
12	1,6510	1,007	1,6395	192,3	1,011
13	1,6634	1,012	1,6437	192,8	1,013
14	1,4087	1,010	1,3947	163,6	0,860
15	1,6662	1,011	1,6481	193,4	1,016
16	1,6061	1,008	1,5933	187,0	0,982
17	1,6176	1,011	1,6000	187,7	0,986
18	0,8831	1,010	0,8743	102,6	0,539
19	1,6367	1,009	1,6221	190,3	1,000
20	1,6271	1,012	1,6078	188,6	0,991
21	1,4650	1,010	1,4505	170,2	0,894
22	1,5556	1,000	1,5556	182,5	0,959
23	0,7939	1,005	0,7899	92,7	0,487
24	1,6357	1,011	1,6179	189,8	0,997
25	1,2256	1,008	1,2159	142,6	0,749
26	1,5832	1,011	1,5660	183,7	0,965
27	1,6462	1,011	1,6283	191,1	1,004
28	1,3925	1,012	1,3760	161,4	0,848
29	1,5823	0,999	1,5839	185,8	0,976
30	1,6586	0,999	1,6603	194,8	1,023

ENEL	Table 2e A.R. ≠ 31B $S/S_{16} = 1{,}070$ 3597 MWD/MTU
Data: 7-3-1967	Integrated Aeroball Activities and Ratios of Integrated Activities to Activity in the Reference Aeroball (No 19)
Calcolato: AL / Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$	C_J	$I_{Jc} = \frac{I_J}{C_J}$	$\frac{I_{Jc}}{\frac{S}{S_{16}}}$ MW(t)	$\frac{I_{Jc}}{I_{19c}}$
1	0,6513	1,0039	0,6488	73,9	0,382
2	0,9565	1,0140	0,9433	107,4	0,556
3	0,9193	1,0062	0,9136	104,0	0,538
4	0,7877	1,0120	0,7783	88,6	0,458
5	out	—	—	—	—
6	1,3105	1,0108	1,2965	147,6	0,764
7	0,7939	1,0138	0,7831	89,2	0,461
8	1,6796	1,0055	1,6704	190,2	0,984
10	1,6128	1,0031	1,6078	183,0	0,947
11	1,7950	1,0133	1,7714	201,7	1,043
12	1,7492	1,0044	1,7415	198,2	1,026
13	1,7721	1,0128	1,7497	199,2	1,030
14	out	—	—	—	—
15	1,7606	1,0116	1,7404	198,1	1,025
16	1,7091	1,0060	1,6989	193,4	1,001
17	1,7273	1,0139	1,7036	193,9	1,003
18	0,9303	1,0000	0,9303	105,9	0,548
19	1,7111	1,0078	1,6978	193,3	1,000
20	1,7406	1,0122	1,7196	195,8	1,013
21	1,5470	1,0083	1,5343	174,7	0,904
22	1,6796	1,0065	1,6687	190,0	0,983
23	0,8402	1,0080	0,8335	94,9	0,491
24	1,7406	1,0137	1,7171	195,5	1,011
25	1,2942	1,0128	1,2778	145,5	0,753
26	1,6748	1,0100	1,6582	188,8	0,977
27	1,7511	1,0105	1,7329	197,3	1,021
28	1,4526	1,0037	1,4472	164,7	0,852
29	1,6815	1,0109	1,6634	189,3	0,980
30	1,7864	1,0131	1,7633	200,7	1,039

ENEL	Table 2f A.R. # 32B $S/S_{16} = 1{,}050$ 3638 MWD/MTU
Data: 7 - 3 - 1967	Integrated Aeroball Activities and Ratios of Integrated Activities to Activity in the Reference Aeroball (No 19)
Calcolato: AL / Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$	C_J	$I_{Jc} = \frac{I_J}{C_J}$	$\frac{I_{Jc}}{\frac{S}{S_{16}} MW(t)}$	$\frac{I_{Jc}}{I_{19c}}$
1	0,6380	1,0053	0,6346	73,6	0,379
2	0,9365	1,0222	0,9162	106,2	0,547
3	0,8974	1,0080	0,8903	103,2	0,531
4	0,7729	1,0163	0,7605	88,2	0,454
5	1,5527	1,0264	1,5128	175,4	0,902
6	1,2761	1,0145	1,2579	145,9	0,751
7	0,7868	1,0209	0,7707	89,4	0,460
8	1,6834	1,0356	1,6255	188,5	0,970
10	1,6195	1,0357	1,5637	181,3	0,933
11	1,7854	1,0295	1,7342	201,1	1,035
12	1,7683	1,0357	1,7073	198,0	1,019
13	1,7559	1,0308	1,7034	197,5	1,016
14	out	—	—	—	—
15	1,7568	1,0326	1,7013	197,3	1,015
16	1,7368	1,0355	1,6772	194,5	1,001
17	1,7168	1,0272	1,6713	193,8	0,997
18	0,9093	1,0000	0,9093	105,4	0,542
19	1,7349	1,0352	1,6759	194,3	1,000
20	1,7416	1,0317	1,6881	195,8	1,008
21	1,5604	1,0350	1,5076	174,8	0,900
22	1,6958	1,0357	1,6373	189,9	0,977
23	0,8235	1,0105	0,8149	94,5	0,486
24	1,7139	1,0280	1,6672	193,3	0,995
25	1,2714	1,0180	1,2489	144,8	0,745
26	1,6595	1,0338	1,6052	186,1	0,958
27	1,7540	1,0336	1,6970	196,8	1,013
28	1,4688	1,0322	1,4230	165,0	0,849
29	1,6824	1,0333	1,6282	188,9	0,971
30	1,7702	1,0301	1,7185	199,2	1,025

ENEL		Table 2g A.R. #33 A $S/S_{16} = 1{,}067$ 3743 MWD/MTU
Data: 8-3-1967		Integrated Aeroball Activities and Ratios of Integrated Activities to Activity in the Reference Aeroball (No 19)
Calcolato: AL	Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$	C_J	$I_{Jc} = \frac{I_J}{C_J}$	$\frac{I_{Jc}}{\frac{S}{S_{16}}}$ MW(t)	$\frac{I_{Jc}}{I_{19c}}$
1	0,6327	1,0046	0,6298	71,8	0,378
2	0,9274	1,0135	0,9150	104,3	0,549
3	0,8859	1,0000	0,8859	101,0	0,532
4	0,7448	1,0106	0,7370	84,0	0,443
5	1,5270	1,0142	1,5056	171,6	0,904
6	1,2666	1,0077	1,2569	143,3	0,755
7	0,7662	1,0121	0,7570	86,3	0,455
8	out	—	—	—	—
10	1,6376	1,0126	1,6172	184,3	0,971
11	1,7559	1,0150	1,7299	197,2	1,039
12	1,7196	1,0126	1,6982	193,6	1,020
13	1,7187	1,0149	1,6935	193,0	1,017
14	1,4802	1,0128	1,4615	166,6	0,878
15	1,7311	1,0141	1,7070	194,6	1,025
16	1,6347	1,0126	1,6143	185,2	0,969
17	1,6948	1,0148	1,6701	190,4	1,003
18	0,9141	1,0140	0,9015	102,7	0,541
19	1,6863	1,0126	1,6653	189,8	1,000
20	1,7025	1,0148	1,6777	191,2	1,007
21	1,5212	1,0126	1,5023	171,2	0,902
22	1,6347	1,0026	1,6305	185,8	0,979
23	0,8249	1,0063	0,8197	93,4	0,492
24	1,6910	1,0149	1,6662	189,9	1,000
25	1,2599	1,0114	1,2457	142,0	0,748
26	1,6433	1,0128	1,6225	184,9	0,974
27	1,7177	1,0132	1,6953	193,2	1,018
28	1,3343	1,0126	1,3177	150,2	0,791
29	1,6500	1,0138	1,6275	185,5	0,977
30	1,7502	1,0149	1,7245	196,6	1,035

ENEL	Table 2h A.R. ≠ 35 A $S/S_{16} = 1.112$ 4257 MWD/MTU
Data: 8-3-1967	Integrated Aeroball Activities and Ratios of Integrated Activities to Activity in the Reference Aeroball (No 19)
Calcolato: AL / Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$	C_J	$I_{Jc} = \frac{I_J}{C_J}$	$\frac{I_{Jc}}{\frac{S}{S_{16}} MW(t)}$	$\frac{I_{Jc}}{I_{19c}}$
1	0,6752	1,002	0,6738	73,2	0,381
2	0,9785	1,014	0,9650	104,8	0,546
3	0,9408	1,000	0,9408	102,2	0,532
4	0,7972	1,009	0,7901	85,8	0,447
5	1,6100	1,016	1,5846	172,1	0,897
6	1,3343	1,005	1,3277	144,2	0,751
7	0,8225	1,011	0,8135	88,4	0,460
8	out	—	—	—	—
10	1,7444	1,023	1,7052	185,2	0,965
11	1,8541	1,019	1,8195	197,6	1,030
12	1,8274	1,023	1,7863	194,0	1,011
13	1,8102	1,021	1,7730	192,6	1,003
14	1,6014	1,023	1,5654	170,0	0,886
15	1,8198	1,022	1,7806	193,4	1,008
16	1,7568	1,023	1,7173	186,5	0,972
17	1,7931	1,018	1,7614	191,3	0,997
18	0,9766	1,015	0,9622	104,5	0,545
19	1,8074	1,023	1,7668	191,9	1,000
20	1,7998	1,021	1,7628	191,5	0,998
21	1,6281	1,023	1,5915	172,9	0,901
22	1,7254	1,001	1,7237	187,2	0,976
23	0,8769	1,004	0,8734	94,9	0,494
24	1,7807	1,019	1,7474	189,8	0,989
25	1,3209	1,010	1,3078	142,1	0,740
26	1,7139	1,023	1,6754	182,0	0,948
27	1,8198	1,023	1,7789	193,2	1,007
28	1,4230	1,023	1,3910	151,1	0,787
29	1,7111	1,022	1,6743	181,9	0,948
30	1,8255	1,020	1,7897	194,4	1,013

ENEL	Table 3a A.R. # 37 B 9769 MWD/MTU
Data: 13 - 3 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: AL / Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	3,712	0,997	3,723	0,593	
3	3,544	1,0041	3,529	0,563	
4	3,154	1,0070	3,132	0,499	
5	5,722	1,0150	5,637	0,904	
6	4,885	1,0127	4,823	0,769	
7	3,151	1,0093	3,122	0,498	
8	6,041	1,0167	5,941	0,947	
10	6,020	1,0173	5,917	0,943	
11	6,423	1,0182	6,308	1,006	
12	6,466	1,0181	6,351	1,012	
13	6,208	1,0180	6,098	0,972	
14	5,737	1,0160	5,646	0,900	
15	6,404	1,0179	6,291	1,003	
16	6,311	1,0177	6,201	0,989	
17	6,314	1,0174	6,206	0,989	
18	3,748	1,0112	3,706	0,591	
19	6,381	1,0173	6,272	1,000	
20	6,372	1,0158	6,272	1,000	
21	5,799	1,0165	5,705	0,909	
22	6,287	1,0151	6,193	0,987	
23	3,599	1,0175	3,537	0,564	
24	6,262	1,0163	6,161	0,982	
25	out	—	—	—	
26	6,185	1,0145	6,096	0,972	
27	out	—	—	—	
28	5,260	1,0168	5,173	0,825	
29	6,243	1,0160	6,144	0,979	
30	6,475	1,0158	6,374	1,016	

ENEL	Table 3b A.R. # 38 B 9850 MWD/MTU
Data: 13-3-1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: AL / Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	6,230	0,9938	6,269	0,599	
3	5,838	0,9825	5,942	0,567	
4	5,319	0,9872	5,388	0,515	
5	9,511	0,9988	9,522	0,909	
6	7,869	0,9850	7,989	0,763	
7	5,199	0,9900	5,251	0,501	
8	10,129	1,0160	9,969	0,952	
10	10,040	1,0175	9,867	0,942	
11	10,715	1,0043	10,669	1,019	
12	10,734	1,0168	10,556	1,008	
13	10,509	1,0080	10,425	0,996	
14	9,691	1,0143	9,554	0,912	
15	10,662	1,0112	10,543	1,007	
16	10,429	1,0057	10,369	0,990	
17	10,564	1,0027	10,535	1,006	
18	6,262	0,9950	6,293	0,601	
19	10,689	1,0209	10,470	1,000	
20	10,845	1,0195	10,637	1,016	
21	9,889	1,0204	9,691	0,925	
22	10,442	0,9862	10,588	1,011	
23	5,906	0,9838	6,003	0,573	
24	10,539	1,0190	10,342	0,988	
25	out	—	—	—	
26	10,620	1,0232	10,379	0,991	
27	11,064	1,0233	10,812	1,033	
28	8,885	1,0092	8,804	0,841	
29	10,469	1,0125	10,339	0,987	
30	10,786	1,0070	10,711	1,023	

ENEL	Table 3c A.R. # 39 B 10038 MWD/MTU
Data: 13 - 3 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: AL / Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	6,066	1,000	6,066	0,601	
3	5,789	1,000	5,789	0,574	
4	5,167	1,000	5,167	0,512	
5	out	—	—	—	
6	7,841	1,001	7,833	0,776	
7	5,131	1,001	5,125	0,508	
8	9,642	1,003	9,613	0,952	
10	9,798	1,003	9,769	0,968	
11	10,175	1,004	10,134	1,004	
12	10,258	1,004	10,217	1,012	
13	10,064	1,004	10,023	0,993	
14	9,381	1,002	9,362	0,928	
15	10,087	1,004	10,047	0,996	
16	10,122	1,005	10,072	0,998	
17	10,282	1,014	10,140	1,005	
18	5,963	1,001	5,957	0,590	
19	10,121	1,003	10,091	1,000	
20	10,268	1,013	10,136	1,004	
21	9,243	1,005	9,197	0,911	
22	out	—	—	—	
23	5,846	1,001	5,840	0,579	
24	9,987	1,012	9,868	0,978	
25	out	—	—	—	
26	out	—	—	—	
27	10,408	1,013	10,274	1,018	
28	out	—	—	—	
29	10,137	1,013	10,006	0,991	
30	10,249	1,013	10,117	1,003	

ENEL		Table 3d A.R. 40 B 10557 MWD/MTU Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Data: 13 - 3 - 1967		
Calcolato: AL	Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	1,7180	1,0035	1,7120	0,614	
3	1,6295	1,0017	1,6267	0,583	
4	1,4535	1,0012	1,4518	0,508	
5	2,5877	1,0070	2,5697	0,922	
6	2,2268	1,0047	2,2164	0,795	
7	1,4507	1,0008	1,4495	0,520	
8	2,7070	1,0081	2,6852	0,964	
10	2,7155	1,0088	2,6878	0,965	
11	2,8942	1,0105	2,8641	1,028	
12	2,8729	1,0101	2.8442	1,021	
13	2,7967	1,0094	2,7707	0,994	
14	out	—	—	—	
15	2,8942	1,0102	2,8650	1,028	
16	2,8550	1,0107	2,8248	1,014	
17	2,8639	1,0107	2,8336	1,017	
18	1,6939	1,0031	1,6887	0,606	
19	2,8152	1,0105	2,7859	1,000	
20	2,8488	1,0000	2,8488	1,022	
21	2,6011	1,0063	2,5848	0,928	
22	out	—	—	—	
23	1,6625	1,0026	1,6582	0,595	
24	2,7855	1,0092	2,7601	0,991	
25	out	—	—	—	
26	2,7597	1,0100	2,7324	0,981	
27	2,9687	1,0095	2,9408	1,056	
28	out	—	—	—	
29	2,7704	1,0107	2,7411	0,984	
30	2,8908	1,0103	2,8613	1,027	

ENEL	Table 3e A.R. # 42 A 10736 MWD/MTU
Data: 24 - 4 - 67	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: / Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	3,070	1,020	3,010	0,599	
3	2,958	1,011	2,926	0,583	
4	2,575	1,008	2,555	0,509	
5	4,735	1,029	4,602	0,916	
6	3,975	1,025	3,877	0,770	
7	2,543	1,005	2,530	0,504	
8	out	—	—	—	
10	4,934	1,033	4,776	0,951	
11	5,254	1,042	5,042	1,004	
12	5,306	1,043	5,087	1,013	
13	5,083	1,036	4,906	0,977	
14	4,754	1,031	4,611	0,918	
15	5,253	1,039	5,056	1,007	
16	out	—	—	—	
17	5,235	1,041	5,029	1,001	
18	3,000	1,018	2,947	0,587	
19	5,222	1,040	5,021	1,000	
20	5,110	1,014	5,040	1,004	
21	4,710	1,026	4,591	0,914	
22	5,216	1,044	4,996	0,995	
23	2,910	1,016	2,864	0,570	
24	5,139	1,035	4,965	0,989	
25	out	—	—	—	
26	5,232	1,037	5,045	1,005	
27	5,340	1,044	5,115	1,019	
28	out	—	—	—	
29	5,092	1,041	4,892	0,974	
30	5,308	1,043	5,089	1,013	

ENEL		Table 4a A.R. ≠ 16 A 2673 MWD/MTU Activities Integrated Over Core Unrodded Portion and Ratios of said Activities to Activity in the Reference Aeroball. Control Group Position: 193 Steps
Data: 15 - 3 - 1967		
Calcolato: SV	Verificato: GB	

J	$I_{JP}=\sum_{1}^{36} {}_n I_{Jn}$	Elapsed Time (E.T.) min.	C_J	I'_{JP} corrected for E.T. and C_J	$\frac{I'_{JP}}{I'_{19P}}$
1	244431	88,4	0,997	3654	0,372
2	298894	128,4	1,013	5252	0,534
3	338899	92.4	0,999	5130	0,522
4	268706	109,4	1,006	4358	0,444
5	466612	140,4	1,018	8612	0,876
6	468642	105,4	1,004	7681	0,782
7	264953	121,4	1,011	4524	0,460
8	407601	194,4	1,036	9409	0,958
10	646075	84,4	0,996	9482	0,965
11	515245	157,4	1,024	1,0193	1,037
12	440829	198,4	1,038	10340	1,053
13	487905	165,4	1,021	9981	1,016
14	340468	207,4	1,040	8305	0,845
15	467226	181,4	1,032	10208	1,040
16	out	—	—	—	—
17	534075	145,4	1,020	10051	1,023
18	276075	132,4	1,015	4931	0,503
19	389637	215,4	1,043	9824	1,000
20	464268	173,4	1,029	9820	1,000
21	348800	211,4	1,042	8652	0,881
22	381011	219,4	1,044	9761	0,994
23	318001	96,4	1,001	4904	0,499
24	508607	149,4	1,021	9739	0,991
25	449769	113,4	1,008	7421	0,755
26	out	—	—	—	—
27	464586	177,4	1,031	9991	1,017
28	out	—	—	—	—
29	418555	189,4	1,035	9463	0,963
30	490158	161,4	1,025	9872	1,005

ENEL	Table 4b A.R. # 19B 2726 MWD/MTU
Data: 16-3-1967	Activities Integrated Over Core Unrodded Portion and Ratios of said Activities to Activity in the Reference Aeroball. Control Group Position: 223 Steps
Calcolato: SV / Verificato: GB	

J	$I_{JP}=\sum_{1}^{41}{}_{n} I_{Jn}$	Elapsed Time (E.T.) min.	C_J	I'_{JP} corrected for E.T. and C_J	$\frac{I'_{JP}}{I'_{19P}}$
1	563356	401,5	1,015	3362	0,376
2	707854	438,5	1,026	4934	0,552
3	801423	405,5	1,017	4860	0,544
4	624933	422,5	1,021	4074	0,456
5	1097302	450,5	1,029	8047	0,902
6	1045497	418,5	1,020	6703	0,750
7	600279	434,5	1,025	4111	0,460
8	838519	535,5	1,048	8821	0,987
10	1513235	395,5	1,000	8923	0,999
11	1192803	467,5	1,033	9405	1,053
12	850887	543,5	1,033	9289	1,039
13	1112650	475,5	1,035	9076	1,016
14	out	—	—	—	—
15	1086817	491,5	1,038	9498	1,063
16	886720	531,5	1,047	9192	1,028
17	1215556	454,5	1,030	9068	1,014
18	657645	442,5	1,027	4667	0,522
19	902056	519,5	1,044	8934	1,000
20	1093861	483,5	1,036	9239	1,034
21	826624	515,5	1,043	8006	0,896
22	881766	527,5	1,046	8986	1,006
23	721100	409,5	1,018	4388	0,491
24	1178567	459,5	1,031	8982	1,005
25	1022207	426,5	1,022	6777	0,759
26	972884	507,5	1,045	9073	1,015
27	1002877	503,5	1,041	9222	1,032
28	887847	487,5	1,037	7628	0,854
29	970906	499,5	1,040	8777	0,982
30	1077904	471,5	1,034	8644	0,967

ENEL	Table 5 — A.R. # 38B — 9850 MWD/MTU
Data: 17-3-1967	Assembly Powers Calculated from A.R. # 38B and their Deviations from Theoretical Values –
Calcolato: GB — Verificato: SV	$P_{ref}/I_{ref} = 0{,}8848$

Assembly number	Aeroball number	$\frac{P_i}{P_{ref}}$ (1)	$\frac{I_{ref}}{I_J}$ (2)	$\frac{P_i}{I_J}$ (3)	$\int_0^{104.6} I_{Jn}$ (4)	P_i (5)	$\frac{P_i}{P_{ave}}$ (6)	$\frac{P_i}{P_{ave}}$ (7)	% Deviation (8)
i	J	Theoretical	Theoretical	$(3)=(1)\times(2)\times0{,}8848$	Experimental	$(5)=(4)\times(3)$	$(6)=\frac{(5)}{(\bar{5})}$	$(7)=\frac{(1)}{(\bar{1})}$	$(8)=100\times\frac{(6)-(7)}{(7)}$
1	22	1,0159	0,9843	0,8848	10588	93683	1,1092	1,128	-1,7
2	17	1,0131	0,9881	0,8857	10535				
	20		0,9920	0,8892	10637	93770	1,1102	1,125	-1,4
	22		0,9843	0,8823	10588				
3	20	1,0093	0,9920	0,8859	10637	94137	1,1146	1,121	-0,6
4	19	1,0000	1,0000	0,8848	10470	92639	1,0968	1,110	-1,2
5	21	0,9850	1,1033	0,9616	9691	93188	1,1033	1,094	+0,8
6	18	0,7309	1,7306	1,1192	6293	70419	0,8337	0,814	+2,4
7	16	1,0130	0,9876	0,8852	10369	91786	1,0867	1,125	-3,4
8	17	1,0132	0,9881	0,8858	10535	93319	1,1048	1,125	-1,8
9	15	1,0153	0,9850	0,8849	10543	93295	1,1046	1,127	-2,0
10	24	1,0537	1,0317	0,9619	10342	99480	1,1778	1,170	+0,7
11	14	0,9583	1,1168	0,9469	9554	90467	1,0710	1,064	+0,6
12	23	0,6492	1,8135	1,0417	6003	62533	0,7404	0,721	+2,7
13	12	1,0088	0,9920	0,8854	10556	93463	1,1066	1,120	-1,2
14	11	1,0154	0,9850	0,8849	10669	95042	1,1253	1,128	-0,3
	27		0,9850	0,8849	10812				
15	13	1,0642	1,0230	0,9633	10425	100204	1,1864	1,182	+0,4
	26		1,0230	0,9633	10379				
16	10	1,0260	1,0603	0,9625	9867	94920	1,1238	1,139	-1,3
17		0,9419	2,0161	1,6802	5251				
	10		1,0603	0,8836	9867	88090	1,0430	1,046	-0,3
	14		1,1168	0,9307	9554				
18	7	0,5518	2,0161	0,9843	5251	52410	0,6205	0,613	+1,2
	23		1,8135	0,8854	6003				
19	30	0,9985	1,0000	0,8835	10711	94578	1,1197	1,109	+1,0
20	29	1,0555	1,0317	0,9635	10339	99616	1,1794	1,172	+0,6
21	8	1,0155	1,0603	0,9527	9969	94975	1,1245	1,128	-0,3
22	28	0,8798	1,2209	0,9504	8804	83673	0,9906	0,977	+1,4
23	7	0,5929	2,0161	1,0576	5251	55534	0,6575	0,658	0,0

ENEL	Table 5 CONT'D A.R. # 38B 9850 MWD/MTU
Data: 17-3-1967	Assembly Powers Calculated from A.R.# 38B and their Deviations from Theoretical Values – $P_{ref}/I_{ref} = 0{,}8848$
Calcolato: GB / Verificato: SV	

Assembly number	Aeroball number	$\frac{P_i}{P_{ref}}$ (1)	$\frac{I_{ref}}{I_J}$ (2)	$\frac{P_i}{I_J}$ (3)	$\int_0^{104.6} I_{Jn}$ (4)	P_i (5)	$\frac{P_i}{P_{ave}}$ (6)	$\frac{P_i}{P_{ave}}$ (7)	% Deviation (8)
i	J	Theoretical	Theoretical	$(3)=(1)\times(2)\times 0{,}8848$	Experimental	$(5)=(4)\times(3)$	$(6)=\frac{(5)}{\overline{(5)}}$	$(7)=\frac{(1)}{\overline{(1)}}$	$(8)=100\times\frac{(6)-(7)}{(7)}$
24	5	0,9758	1,1168	0,9642	9522	91955	1,0887	1,084	+0,4
	29		1,0317	0,8908	10339				
25	5	0,9719	1,1168	0,9604	9522	91449	1,0827	1,079	+0,3
26	6	0,9370	1,3235	1,0973	7989	87663	1,0379	1,040	-0,2
27	4	0,6429	2,0161	1,1468	5388	61789	0,7316	0,714	+2,5
28	2	0,6814	1,7306	1,0434	6269	65411	0,7744	0,757	+2,3
29	3	0,6943	1,8135	1,1141	5942	66200	0,7837	0,771	+1,6
30	3	0,5066	1,8135	0,8129	5942				
	4		2,0161	0,9037	5388	48128	0,5698	0,563	+1,2
	6		1,3235	0,5932	7989				

ENEL	Table 6a	A. R. # 18 A	2686 MWD/MTU
Data: 22-2-1967	Ratio of Axial Maximum to Average Activity -		
Calcolato: OB / Verificato: GB			

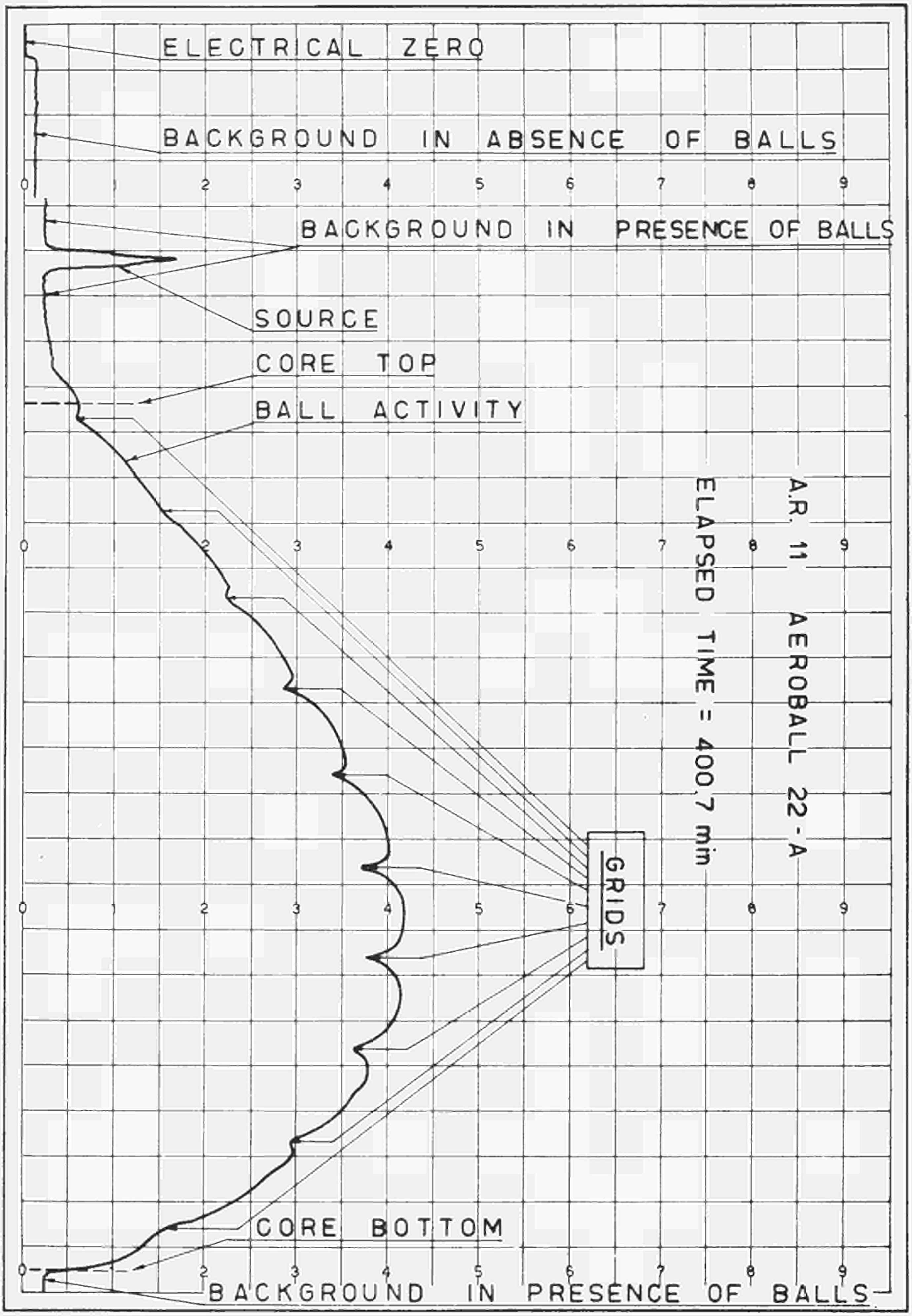
J	Axial Maximum	Axial Average	Maximum / Average	Peak Location	
1	2,2864	1,6640	1,374	26	
2	2,7351	1,9316	1,416	21	
3	3,1509	2,2652	1,391	27	
4	2,5273	1,8169	1,391	22	
5	4,1854	3,0263	1,383	22	
6	4,2280	3,1505	1,342	21	
7	2,3997	1,7153	1,399	23	
8	3,1746	2,3021	1,379	26	
10	5,8814	4,2836	1,373	26	
11	4,5209	3,3890	1,334	22	
12	3,1982	2,4028	1,331	22	
13	4,1571	3,0908	1,345	21	
14	3,1037	2,3283	1,333	20	
15	4,0391	2,9354	1,376	22	
16	out	—	—	—	
17	4,7334	3,5350	1,339	22	
18	2,6689	1,8381	1,452	21	
19	3,2974	2,4848	1,327	26	
20	3,9681	3,0477	1,302	25	
21	3,1366	2,2151	1,416	20	
22	3,3303	2,5403	1,311	19	
23	2,8721	2,0707	1,387	19	
24	4,4973	3,2851	1,369	21	
25	4,1194	3,0090	1,369	22	
26	3,5240	2,5648	1,374	21	
27	3,7272	2,8173	1,323	29	
28	out	—	—	—	
29	3,8973	2,7601	1,412	26	
30	4,3650	3,1493	1,386	22	

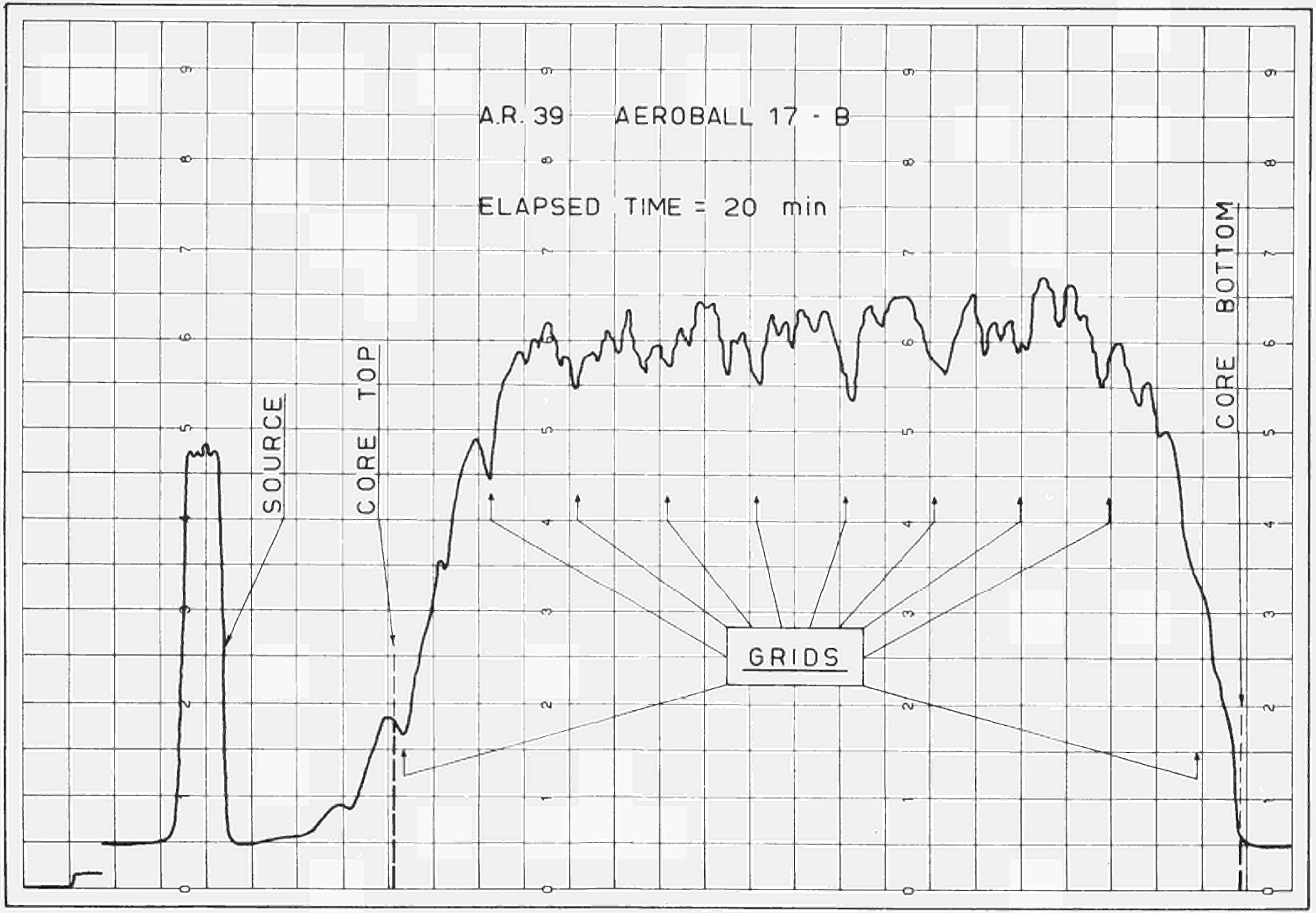
ENEL	Table 6b A. R. # 24 A 2803 MWD/MTU
Data: 22-2-1967	Ratio of Axial Maximum to Average Activity -
Calcolato: OB / Verificato: GB	

J	Axial Maximum	Axial Average	Maximum / Average	Peak Location	
1	3,1599	2,2964	1,376	30	
2	4,2400	3,0005	1,413	35	
3	4,2899	3,1681	1,354	35	
4	3,5049	2,5535	1,373	32	
5	6,4750	4,7949	1,350	30	
6	5,9599	4,4186	1,349	32	
7	3,4199	2,5162	1,359	31	
8	5,1200	3,8411	1,333	33	
10	8,2149	6,1249	1,341	35	
11	7,0498	5,1749	1,362	35	
12	5,1898	3,9119	1,327	36	
13	6,6199	4,9066	1,349	35	
14	5,0250	3,7306	1,347	36	
15	6,2548	4,6421	1,347	33	
16	out	—	—	—	
17	6,8299	5,1264	1,332	32	
18	3,8699	2,8645	1,351	36	
19	5,5550	4,1689	1,332	30	
20	6,3848	4,6980	1,359	35	
21	out	—	—	—	
22	5,4000	3,9752	1,358	31	
23	3,9948	2,8887	1,383	31	
24	6,6900	5,0855	1,315	32	
25	5,6699	4 2472	1,335	31	
26	5,9449	4,2286	1,406	32	
27	6,1749	4,4633	1,383	32	
28	4,9598	3,6877	1,345	28	
29	6,0400	4,3999	1,373	31	
30	7,0050	5,0743	1,380	35	

ENEL	Table 6 c A. R. ≠ 30 B 3495 MWD/MTU
Data: 23-2-1967	Ratio of Axial Maximum to Average Activity -
Calcolato: OB Verificato: GB	

J	Axial Maximum	Axial Average	Maximum / Average	Peak Location	
1	3,5186	2,6337	1,336	30	
2	4,2800	3,2375	1,322	30	
3	4,7457	3,6171	1,312	26	
4	3,8032	2,9143	1,305	31	
5	6,7840	5,1394	1,320	27	
6	6,2887	4,8863	1,287	31	
7	3,6941	2,7859	1,326	32	
8	4,6274	3,5513	1,303	27	
10	4,2541	3,2131	1,324	30	
11	7,0686	5,5008	1,285	31	
12	4,6736	3,5731	1,308	31	
13	6,7360	5,1617	1,305	32	
14	4,7142	3,6403	1,295	27	
15	6,2887	4,8561	1,295	29	
16	4,7586	3,7090	1,283	30	
17	7,1574	5,5873	1,281	31	
18	5,0561	3,8596	1,310	31	
19	5,1688	4,0162	1,287	30	
20	6,3017	4,9464	1,274	31	
21	4,7087	3,6587	1,287	31	
22	4,7179	3,7003	1,275	26	
23	4,3761	3,2682	1,339	24	
24	7,0372	5,5064	1,278	36	
25	6,0540	4,6967	1,289	32	
26	5,6031	4,2936	1,305	28	
27	5,9228	4,5630	1,298	31	
28	5,3463	4,1348	1,293	32	
29	5,8877	4,4638	1,319	32	
30	6,9300	5,3226	1,302	31	


ELECTRICAL ZERO
BACKGROUND IN ABSENCE OF BALLS
0 1 2 3 4 5 6 7 8 9
BACKGROUND IN PRESENCE OF BALLS
SOURCE
CORE TOP
BALL ACTIVITY
A.R. 11 AEROBALL 22-A
ELAPSED TIME = 400,7 min
GRIDS
CORE BOTTOM
BACKGROUND IN PRESENCE OF BALLS



A.R. 39 AEROBALL 17 - B
ELAPSED TIME = 20 min
SOURCE
CORE TOP
CORE BOTTOM
GRIDS

ATTACHMENT 1 : "TWO TYPICAL ACTIVITY PROFILES AS
OBTAINED FROM AEROBALL RECORDER"

ENEL	Table 6d A.R. # 31 B 3597 MWD/MTU
Data: 23-2-1967	Ratio of Axial Maximum to Average Activity -
Calcolato: OB / Verificato: GB	

J	Axial Maximum	Axial Average	$\frac{\text{Maximum}}{\text{Average}}$	Peak Location	
1	3,3597	2,5147	1,336	30	
2	4,2564	3,1459	1,353	30	
3	4,5479	2,7208	1,304	34	
4	3,6512	2,7766	1,315	30	
5	out	—	—	—	
6	6,0571	4,7210	1,283	31	
7	3,4815	2,6617	1,308	30	
8	4,5663	3,4937	1,307	32	
10	4,0940	3,1372	1,305	36	
11	6,6789	5,2097	1,282	31	
12	4,6383	3,5624	1,302	32	
13	6,4851	4,9656	1,306	31	
14	out	—	—	—	
15	6,1198	4,6083	1,328	34	
16	4,7601	3,6254	1,313	32	
17	6,7730	5,2749	1,284	35	
18	4,7137	3,4432	1,369	31	
19	4,8947	3,8480	1,272	36	
20	6,1383	4,7218	1,300	32	
21	4,5977	3,5421	1,298	35	
22	4,6383	3,6208	1,281	36	
23	4,2066	3,1416	1,339	34	
24	6,8689	5,2275	1,314	35	
25	5,7564	4,4867	1,283	31	
26	5,4907	4,1037	1,338	34	
27	5,7914	4,3544	1,330	25	
28	3,6845	2,8808	1,279	31	
29	5,6346	4,2589	1,323	36	
30	6,8283	5,0881	1,342	35	

ENEL	Table 6e A.R. # 35A 4257 MWD/MTU
Data: 23-2-1967	Ratio of Axial Maximum to Average Activity –
Calcolato: OB / Verificato: GB	

J	Axial Maximum	Axial Average	Maximum / Average	Peak Location	
1	3,3236	2,5106	1,324	30	
2	3,9065	3,0303	1,289	34	
3	4,7661	3,6319	1,312	33	
4	3,5311	2,7118	1,302	30	
5	6,0288	4,7427	1,271	35	
6	5,9715	4,7949	1,245	32	
7	3,4777	2,6838	1,296	32	
8	out	—	—	—	
10	3,5588	2,7937	1,274	32	
11	6,2264	4,9794	1,251	35	
12	3,8255	3,0340	1,261	31	
13	5,6632	4,5192	1,253	32	
14	3,9303	3,1271	1,257	35	
15	5,2818	4,1503	1,273	30	
16	3,9836	3,0731	1,296	35	
17	6,0485	4,9849	1,213	32	
18	3,8255	2,9465	1,298	31	
19	4,02[illegible]1	3,2445	1,230	36	
20	5,4261	4,4111	1,230	30	
21	3,7662	2,9707	1,268	36	
22	8,0226	6,5347	1,228	35	
23	4,1674	3,2072	1,299	29	
24	6,0090	4,8656	1,235	36	
25	5,4557	4,4148	1,236	35	
26	4,3788	3,4512	1,269	34	
27	4,9005	3,7306	1,313	36	
28	3,1161	2,3188	1,344	32	
29	5,0348	3,8374	1,312	36	
30	5,8984	4,6384	1,272	32	

ATTACHMENT 2 : "TYPICAL SNAPSHOT AND RAW DATA LOGGED BY PRODAC-510 COMPUTER ".

SNAPSHOT & RAW DATA OF RUN # 18A TAKEN ON OCT, 20, 1965

RFD 10000/377/1/ — TIME IN, SEC

DEC 10000/10002// — TIME OUT, SEC

10000 + 66100.0 + 66700.0 + 36.0 — DAY

DEC 10003/10003/6/

10003 + 286.000 TG. — TRIM GROUP POSITION, STEPS

DEC 10004/10004/10/

10004 + 199.000 C.G. — CONTROL GROUP POSITION, STEPS

DEC 10005/10005/7/

10005 + 494.523 PTT — THERMAL POWER, MWt

DEC 10006/10043/7/

10006	+ 282.695	+ 284.304	+ 285.382	+ 288.773	+ 291.601	+ 292.132	+ 280.937	+ 292.828
10016	+ 281.726	+ 289.289	+ 292.328	+ 289.929	+ 294.445	+ 289.078	+ 291.031	+ 277.914
10026	+ 292.726	+ 285.101	+ 290.492	+ 291.539	+ 290.453	+ 292.820	+ 285.851	+ 291.343
10036	+ 290.531	+ 293.351	+ 292.203	+ 289.484	+ 292.289	+ 291.015		

30 THERMOCOUPLES DATA, °C

DEC 10044/10047/7/

10044 + 266.984 + 266.312 + 267.562 + 266.484

DEC 10050/10050/10/

10050 + 140.593

VESSEL PRESSURE, Kg/cm²

COLD LEG WATER TEMPERATURES, °C

READ - OUT TIME, SEC

MOLTIPLICATION FACTOR OF INSTRUMENTATION

AEROBALL (J) NUMBER-THE SCANNING OF THIS AEROBALL IS REPEATED : IT IS A "MONITOR"

RFD 10000/400/3/

DAY

10000	+ 68379.0	+ 36.0	+ 7.0	+ 10.0				
10004	+ 1.02563	+ 1.09521	+ 1.11645	+ 1.13916	+ 1.16894	+ 1.18847	+ 1.20556	+ 1.20996
10014	+ 1.22119	+ 1.24609	+ 1.25463	+ 1.25170	+ 1.25805	+ 1.25708	+ 1.27880	+ 1.28173
10024	+ 1.28491	+ 1.27978	+ 1.28710	+ 1.29443	+ 1.28662	+ 1.28979	+ 1.29003	+ 1.27954
10034	+ 1.29882	+ 1.30395	+ 1.29785	+ 1.28808	+ 1.27075	+ 1.28637	+ 1.28076	+ 1.28051
10044	+ 1.26416	+ 1.23339	+ 1.24340	+ 1.21948	+ 1.21166	+ 1.18847	+ 1.16674	+ 1.16479
10054	+ 1.15307	+ 1.14892	+ 1.13330	+ 1.11791	+ 1.10522	+ 1.09277	+ 1.07714	+ 1.06665
10064	+ 1.05810	+ 1.05444	+ 1.00415					

VALUE OF BACKGROUND WITHOUT BALLS ON THE READING PLATE

10067	+ 68619.0	+ 36.0	+ 7.0	+ 1.0				
10073	+ 1.01147	+ 1.03613	+ 1.04589	+ 1.05444	+ 1.06323	+ 1.07348	+ 1.07763	+ 1.08740
10103	+ 1.08300	+ 1.09741	+ 1.09765	+ 1.09594	+ 1.10815	+ 1.09960	+ 1.10937	+ 1.11230
10113	+ 1.11279	+ 1.11108	+ 1.10668	+ 1.11083	+ 1.11181	+ 1.11401	+ 1.11157	+ 1.10839
10123	+ 1.11718	+ 1.11816	+ 1.11474	+ 1.11425	+ 1.10766	+ 1.11474	+ 1.11376	+ 1.11083
10133	+ 1.10400	+ 1.09545	+ 1.10009	+ 1.09106	+ 1.08374	+ 1.08471	+ 1.07739	+ 1.07348
10143	+ 1.07250	+ 1.06372	+ 1.05639	+ 1.05053	+ 1.04541	+ 1.04028	+ 1.03930	+ 1.03125
10153	+ 1.02343	+ 1.02636	+ 1.00537					
10160	+ 2.0	+ .0	+ .0					

FIRST OF 50 ACTIVITY VALUES (BOTTOM OF THE CORE)

10200	+ 68859.0	+ 36.0	+ 7.0	+ 3.0				
10204	+ 1.01489	+ 1.04956	+ 1.05688	+ 1.07226	+ 1.08813	+ 1.09570	+ 1.10693	+ 1.11279
10214	+ 1.11352	+ 1.12695	+ 1.13281	+ 1.13574	+ 1.13720	+ 1.13818	+ 1.15234	+ 1.15014
10224	+ 1.15625	+ 1.14941	+ 1.15454	+ 1.15625	+ 1.15502	+ 1.15844	+ 1.15502	+ 1.15209
10234	+ 1.15625	+ 1.15698	+ 1.16284	+ 1.15307	+ 1.15014	+ 1.15356	+ 1.15283	+ 1.14282
10244	+ 1.14428	+ 1.12915	+ 1.12866	+ 1.12548	+ 1.11474	+ 1.10717	+ 1.09497	+ 1.09277
10254	+ 1.09155	+ 1.07812	+ 1.07299	+ 1.06665	+ 1.05908	+ 1.05249	+ 1.04296	+ 1.03344
10264	+ 1.03173	+ 1.03320	+ 1.00488					

50 th ACTIVITY VALUE (TOP OF THE CORE)

10267	+ 69099.0	+ 36.0	+ 7.0	+ 23.0				
10273	+ 1.01391	+ 1.06591	+ 1.08007	+ 1.09179	+ 1.09667	+ 1.10742	+ 1.10229	+ 1.12084
10303	+ 1.11499	+ 1.12158	+ 1.13476	+ 1.13403	+ 1.12866	+ 1.13793	+ 1.14428	+ 1.14355
10313	+ 1.13916	+ 1.14794	+ 1.14843	+ 1.14770	+ 1.14819	+ 1.13891	+ 1.14135	+ 1.14160
10323	+ 1.14746	+ 1.14453	+ 1.13671	+ 1.13916	+ 1.14355	+ 1.13085	+ 1.13208	+ 1.11914
10333	+ 1.11914	+ 1.11499	+ 1.10668	+ 1.10058	+ 1.09521	+ 1.09545	+ 1.07983	+ 1.07983
10343	+ 1.06982	+ 1.06030	+ 1.05566	+ 1.05053	+ 1.03955	+ 1.03173	+ 1.03076	+ 1.02832
10353	+ 1.02319	+ 1.01782	+ 1.01513					
10360	+ 4.0	+ .0	+ .0					

10200	+ 70299.0	+ 36.0	+ 7.0	+ 10.0				
10204	+ 1.02465	+ 1.08447	+ 1.09521	+ 1.12036	+ 1.14428	+ 1.16967	+ 1.17407	+ 1.19140
10214	+ 1.19482	+ 1.21557	+ 1.21386	+ 1.23120	+ 1.22778	+ 1.22900	+ 1.24047	+ 1.25195
10224	+ 1.24536	+ 1.24975	+ 1.23730	+ 1.25903	+ 1.26147	+ 1.26000	+ 1.25415	+ 1.24682
10234	+ 1.24877	+ 1.26611	+ 1.26123	+ 1.25610	+ 1.24169	+ 1.25000	+ 1.24609	+ 1.24414
10244	+ 1.22778	+ 1.21313	+ 1.21020	+ 1.19921	+ 1.18432	+ 1.16186	+ 1.14697	+ 1.14819
10254	+ 1.13720	+ 1.12695	+ 1.11572	+ 1.09741	+ 1.09277	+ 1.08178	+ 1.07153	+ 1.05566
10264	+ 1.04711	+ 1.04711	+ 1.00488					
10267	+ 70719.0	+ 36.0	+ 7.0	+ 7.0				
10273	+ 1.01269	+ 1.04052	+ 1.05029	+ 1.05737	+ 1.07031	+ 1.07812	+ 1.08154	+ 1.09277
10303	+ 1.09643	+ 1.10424	+ 1.10571	+ 1.11132	+ 1.10937	+ 1.11035	+ 1.11157	+ 1.11059
10313	+ 1.11865	+ 1.11108	+ 1.11718	+ 1.12109	+ 1.12011	+ 1.12377	+ 1.12402	+ 1.11328
10323	+ 1.11987	+ 1.11669	+ 1.11889	+ 1.11718	+ 1.11083	+ 1.11718	+ 1.11499	+ 1.11743
10333	+ 1.11206	+ 1.10180	+ 1.10253	+ 1.10083	+ 1.09375	+ 1.08959	+ 1.07739	+ 1.07788
10343	+ 1.07739	+ 1.07104	+ 1.06347	+ 1.05737	+ 1.05102	+ 1.04418	+ 1.03955	+ 1.03100
10353	+ 1.02832	+ 1.02734	+ 1.03417					
10360	+ 10.0	+ .0	+ .0					
10400	+ 71079.0	+ 36.0	+ 7.0	+ 7.0				
10404	+ 1.01196	+ 1.03881	+ 1.04492	+ 1.06103	+ 1.06347	+ 1.07519	+ 1.08129	+ 1.08520
10414	+ 1.08740	+ 1.09594	+ 1.09497	+ 1.10644	+ 1.10839	+ 1.10180	+ 1.11206	+ 1.11328
10424	+ 1.11547	+ 1.11132	+ 1.11303	+ 1.12060	+ 1.12182	+ 1.12402	+ 1.11743	+ 1.11718
10434	+ 1.11621	+ 1.11376	+ 1.11596	+ 1.11303	+ 1.11254	+ 1.11987	+ 1.10986	+ 1.10595
10444	+ 1.10473	+ 1.10229	+ 1.10278	+ 1.09448	+ 1.09399	+ 1.08740	+ 1.07934	+ 1.07470
10454	+ 1.07348	+ 1.06616	+ 1.05932	+ 1.05224	+ 1.04687	+ 1.04199	+ 1.03906	+ 1.03100
10464	+ 1.02661	+ 1.02929	+ 1.00341					
10467	+ 71319.0	+ 36.0	+ 7.0	+ 2.0				
10473	+ 1.01293	+ 1.04370	+ 1.05395	+ 1.06689	+ 1.07739	+ 1.08374	+ 1.09423	+ 1.10327
10503	+ 1.09765	+ 1.10766	+ 1.11401	+ 1.12744	+ 1.11523	+ 1.11987	+ 1.12866	+ 1.12304
10513	+ 1.13183	+ 1.12841	+ 1.11987	+ 1.13647	+ 1.14135	+ 1.13281	+ 1.13452	+ 1.14111
10523	+ 1.13305	+ 1.13598	+ 1.12988	+ 1.13476	+ 1.13085	+ 1.13281	+ 1.12963	+ 1.13061
10533	+ 1.12329	+ 1.11059	+ 1.11352	+ 1.10327	+ 1.10302	+ 1.08642	+ 1.08178	+ 1.08203
10543	+ 1.06933	+ 1.06665	+ 1.05395	+ 1.05419	+ 1.04443	+ 1.04150	+ 1.03417	+ 1.03027
10553	+ 1.02734	+ 1.02709	+ 1.00463					
10560	+ 12.0	+ .0	+ .0					

10400	+ 69339.0	+ 36.0	+ 7.0	+ 10.0				
10404	+ 1.02075	+ 1.09008	+ 1.10888	+ 1.13403	+ 1.16235	+ 1.18090	+ 1.18652	+ 1.19921
10414	+ 1.20214	+ 1.22583	+ 1.23535	+ 1.24560	+ 1.24072	+ 1.24731	+ 1.26879	+ 1.26757
10424	+ 1.26635	+ 1.26635	+ 1.26269	+ 1.27587	+ 1.27612	+ 1.27490	+ 1.26513	+ 1.26684
10434	+ 1.28002	+ 1.27514	+ 1.27026	+ 1.27270	+ 1.25146	+ 1.26269	+ 1.25756	+ 1.25097
10444	+ 1.24316	+ 1.22265	+ 1.22583	+ 1.20971	+ 1.19165	+ 1.17089	+ 1.16064	+ 1.15795
10454	+ 1.14306	+ 1.13452	+ 1.12377	+ 1.10131	+ 1.09838	+ 1.08374	+ 1.07690	+ 1.06152
10464	+ 1.05126	+ 1.04907	+ 1.00439					

10467	+ 69579.0	+ 36.0	+ 7.0	+ 6.0				
10473	+ 1.01733	+ 1.07055	+ 1.08789	+ 1.10595	+ 1.12255	+ 1.13354	+ 1.15136	+ 1.15600
10503	+ 1.16186	+ 1.17407	+ 1.17968	+ 1.19335	+ 1.18823	+ 1.19946	+ 1.20214	+ 1.20507
10513	+ 1.20605	+ 1.20092	+ 1.20385	+ 1.21606	+ 1.21850	+ 1.21826	+ 1.21313	+ 1.20849
10523	+ 1.21411	+ 1.21337	+ 1.20996	+ 1.20166	+ 1.20312	+ 1.20458	+ 1.19970	+ 1.19482
10533	+ 1.18969	+ 1.18041	+ 1.18090	+ 1.17578	+ 1.15673	+ 1.15209	+ 1.14062	+ 1.13281
10543	+ 1.12817	+ 1.11499	+ 1.10009	+ 1.09350	+ 1.08544	+ 1.07055	+ 1.06347	+ 1.05419
10553	+ 1.04321	+ 1.04248	+ 1.00463					

10560	+ 6.0	+ .0	+ .0

RFD 10000/403/3/

10000	+ 69819.0	+ 36.0	+ 7.0	+ 4.0				
10004	+ 1.01367	+ 1.03906	+ 1.04931	+ 1.05615	+ 1.06884	+ 1.07861	+ 1.08178	+ 1.08593
10014	+ 1.09277	+ 1.10375	+ 1.10473	+ 1.11108	+ 1.11230	+ 1.10351	+ 1.12280	+ 1.12451
10024	+ 1.12622	+ 1.11962	+ 1.12133	+ 1.12451	+ 1.12475	+ 1.13061	+ 1.12036	+ 1.11962
10034	+ 1.12231	+ 1.12792	+ 1.11938	+ 1.12304	+ 1.12109	+ 1.11474	+ 1.11962	+ 1.11914
10044	+ 1.11010	+ 1.10424	+ 1.09936	+ 1.10693	+ 1.09619	+ 1.09082	+ 1.08349	+ 1.07788
10054	+ 1.07714	+ 1.07519	+ 1.06445	+ 1.05761	+ 1.05322	+ 1.04711	+ 1.04272	+ 1.03369
10064	+ 1.02832	+ 1.03002	+ 1.00390					

10067	+ 70059.0	+ 36.0	+ 7.0	+ 25.0				
10073	+ 1.02099	+ 1.06518	+ 1.08203	+ 1.09643	+ 1.11743	+ 1.12597	+ 1.14428	+ 1.14770
10103	+ 1.15502	+ 1.16918	+ 1.17749	+ 1.17700	+ 1.17504	+ 1.18725	+ 1.19189	+ 1.19580
10113	+ 1.19873	+ 1.19409	+ 1.19921	+ 1.20190	+ 1.21118	+ 1.21289	+ 1.20092	+ 1.19335
10123	+ 1.20483	+ 1.19921	+ 1.20117	+ 1.19848	+ 1.19311	+ 1.19433	+ 1.19628	+ 1.19213
10133	+ 1.18115	+ 1.16699	+ 1.16674	+ 1.16333	+ 1.15405	+ 1.14672	+ 1.13037	+ 1.13549
10143	+ 1.12133	+ 1.11010	+ 1.10180	+ 1.08911	+ 1.08081	+ 1.07177	+ 1.06396	+ 1.04931
10153	+ 1.04248	+ 1.04418	+ 1.00463					

10160	+ 8.0	+ .0	+ .0

10200	+ 73659.0	+ 36.0	+ 7.0	+ 13.0				
10204	+ 1.02075	+ 1.07153	+ 1.08862	+ 1.10229	+ 1.12524	+ 1.14257	+ 1.14843	+ 1.15527
10214	+ 1.15942	+ 1.17724	+ 1.18164	+ 1.18725	+ 1.18774	+ 1.18774	+ 1.19116	+ 1.21215
10224	+ 1.20727	+ 1.20043	+ 1.19921	+ 1.21435	+ 1.21044	+ 1.21484	+ 1.20751	+ 1.20361
10234	+ 1.21142	+ 1.21337	+ 1.20898	+ 1.21289	+ 1.20385	+ 1.20776	+ 1.20629	+ 1.19360
10244	+ 1.18750	+ 1.17846	+ 1.17309	+ 1.16406	+ 1.15576	+ 1.13745	+ 1.12866	+ 1.12036
10254	+ 1.11914	+ 1.10571	+ 1.09423	+ 1.08178	+ 1.07592	+ 1.06494	+ 1.05932	+ 1.04663
10264	+ 1.04003	+ 1.03930	+ 1.00439					
10267	+ 73959.0	+ 36.0	+ 7.0	+ 10.0				
10273	+ 1.01757	+ 1.06518	+ 1.07763	+ 1.09472	+ 1.11450	+ 1.12670	+ 1.14111	+ 1.14697
10303	+ 1.15185	+ 1.16308	+ 1.17431	+ 1.17675	+ 1.17456	+ 1.17333	+ 1.18188	+ 1.19995
10313	+ 1.20141	+ 1.19262	+ 1.18774	+ 1.20263	+ 1.19409	+ 1.19873	+ 1.19287	+ 1.19213
10323	+ 1.19946	+ 1.19702	+ 1.19702	+ 1.19165	+ 1.18359	+ 1.19458	+ 1.19335	+ 1.18603
10333	+ 1.17871	+ 1.16503	+ 1.15771	+ 1.15478	+ 1.14013	+ 1.12451	+ 1.11230	+ 1.11401
10343	+ 1.10913	+ 1.09301	+ 1.09033	+ 1.07543	+ 1.07153	+ 1.06616	+ 1.05590	+ 1.04174
10353	+ 1.03588	+ 1.03808	+ 1.00463					
10360	+ 22.0	+ .0	+ .0					
10400	+ 74199.0	+ 36.0	+ 7.0	+ 20.0				
10404	+ 1.01831	+ 1.06640	+ 1.07763	+ 1.09692	+ 1.11596	+ 1.12866	+ 1.14746	+ 1.15356
10414	+ 1.14868	+ 1.17163	+ 1.16577	+ 1.18359	+ 1.17700	+ 1.18334	+ 1.19018	+ 1.19189
10424	+ 1.19995	+ 1.19555	+ 1.18750	+ 1.19946	+ 1.20288	+ 1.19897	+ 1.20434	+ 1.19799
10434	+ 1.19824	+ 1.20507	+ 1.20166	+ 1.19824	+ 1.18579	+ 1.19921	+ 1.19604	+ 1.19091
10444	+ 1.18334	+ 1.16894	+ 1.17236	+ 1.16992	+ 1.15893	+ 1.15722	+ 1.13647	+ 1.14453
10454	+ 1.13671	+ 1.12158	+ 1.10864	+ 1.09863	+ 1.09082	+ 1.07910	+ 1.07031	+ 1.05712
10464	+ 1.04785	+ 1.04565	+ 1.00439					
10467	+ 74439.0	+ 36.0	+ 7.0	+ 15.0				
10473	+ 1.01953	+ 1.08862	+ 1.11083	+ 1.12548	+ 1.13842	+ 1.14843	+ 1.14501	+ 1.16796
10503	+ 1.17504	+ 1.18212	+ 1.18139	+ 1.16601	+ 1.18847	+ 1.19213	+ 1.19042	+ 1.20410
10513	+ 1.19140	+ 1.20483	+ 1.20288	+ 1.20532	+ 1.20019	+ 1.18872	+ 1.20874	+ 1.20068
10523	+ 1.20190	+ 1.20385	+ 1.18945	+ 1.19873	+ 1.19775	+ 1.19311	+ 1.18774	+ 1.16625
10533	+ 1.17602	+ 1.15722	+ 1.15356	+ 1.14013	+ 1.12036	+ 1.12475	+ 1.11572	+ 1.10717
10543	+ 1.09790	+ 1.08325	+ 1.07885	+ 1.07250	+ 1.06323	+ 1.05078	+ 1.04272	+ 1.03955
10553	+ 1.03271	+ 1.02392	+ 1.00415					
10560	+ 24.0	+ .0	+ .0					

10400	+ 75879.0	+ 36.0	+ 7.0	+ 14.0				
10404	+ 1.01635	+ 1.05493	+ 1.06396	+ 1.07324	+ 1.09106	+ 1.10400	+ 1.11206	+ 1.11230
10414	+ 1.11938	+ 1.13281	+ 1.12719	+ 1.14501	+ 1.13745	+ 1.14233	+ 1.15209	+ 1.15722
10424	+ 1.15380	+ 1.15258	+ 1.14746	+ 1.15991	+ 1.16040	+ 1.15185	+ 1.15673	+ 1.15307
10434	+ 1.16186	+ 1.15234	+ 1.15502	+ 1.15234	+ 1.15185	+ 1.15307	+ 1.15087	+ 1.15112
10444	+ 1.15185	+ 1.13183	+ 1.13891	+ 1.13110	+ 1.12377	+ 1.11181	+ 1.09790	+ 1.10424
10454	+ 1.09545	+ 1.08813	+ 1.08007	+ 1.06909	+ 1.06103	+ 1.05786	+ 1.04931	+ 1.04077
10464	+ 1.03417	+ 1.02954	+ 1.00366					
10467	+ 76119.0	+ 36.0	+ 7.0	+ 10.0				
10473	+ 1.01440	+ 1.05810	+ 1.06811	+ 1.08398	+ 1.09765	+ 1.11328	+ 1.11938	+ 1.12890
10503	+ 1.12646	+ 1.14257	+ 1.14892	+ 1.15234	+ 1.15039	+ 1.15209	+ 1.16821	+ 1.15991
10513	+ 1.16552	+ 1.16625	+ 1.15747	+ 1.17114	+ 1.17114	+ 1.17358	+ 1.17041	+ 1.16699
10523	+ 1.17089	+ 1.17456	+ 1.16625	+ 1.17211	+ 1.16162	+ 1.16772	+ 1.15649	+ 1.15795
10533	+ 1.14990	+ 1.14428	+ 1.13818	+ 1.12597	+ 1.11914	+ 1.10742	+ 1.09985	+ 1.10009
10543	+ 1.09399	+ 1.08129	+ 1.07812	+ 1.06542	+ 1.06176	+ 1.05297	+ 1.04638	+ 1.03735
10553	+ 1.03198	+ 1.03100	+ 1.00463					
10560	+ 30.0	+ .0	+ .0					

RFD 10000/417/3/

10000	+ 76359.0	+ 36.0	+ 7.0	+ 21.0				
10004	+ 1.01416	+ 1.05224	+ 1.06201	+ 1.07812	+ 1.08911	+ 1.10107	+ 1.10571	+ 1.11376
10014	+ 1.12036	+ 1.13134	+ 1.13623	+ 1.13867	+ 1.13964	+ 1.14648	+ 1.14721	+ 1.14233
10024	+ 1.14843	+ 1.14990	+ 1.15283	+ 1.16186	+ 1.16210	+ 1.15063	+ 1.14672	+ 1.15234
10034	+ 1.14990	+ 1.15454	+ 1.15576	+ 1.15136	+ 1.14697	+ 1.15112	+ 1.14672	+ 1.14331
10044	+ 1.13012	+ 1.12475	+ 1.12207	+ 1.11303	+ 1.10498	+ 1.09423	+ 1.09252	+ 1.07958
10054	+ 1.08105	+ 1.08105	+ 1.06518	+ 1.06030	+ 1.05371	+ 1.04711	+ 1.04248	+ 1.03149
10064	+ 1.03002	+ 1.02954	+ 1.00415					
10067	+ 76659.0	+ 36.0	+ 7.0	+ 19.0				
10073	+ 1.01586	+ 1.05737	+ 1.07177	+ 1.08081	+ 1.09350	+ 1.10961	+ 1.12011	+ 1.12670
10103	+ 1.12500	+ 1.13623	+ 1.14770	+ 1.14819	+ 1.15014	+ 1.15161	+ 1.15966	+ 1.16064
10113	+ 1.16503	+ 1.16381	+ 1.15991	+ 1.16625	+ 1.16577	+ 1.16577	+ 1.16674	+ 1.16625
10123	+ 1.16943	+ 1.16772	+ 1.17041	+ 1.16503	+ 1.15893	+ 1.15991	+ 1.16088	+ 1.14794
10133	+ 1.15039	+ 1.14282	+ 1.14526	+ 1.13378	+ 1.12939	+ 1.12207	+ 1.11181	+ 1.10839
10143	+ 1.09765	+ 1.09521	+ 1.08398	+ 1.07543	+ 1.07299	+ 1.06347	+ 1.05102	+ 1.04296
10153	+ 1.03710	+ 1.03491	+ 1.00488					
10160	+ 32.0	+ .0	+ .0					

10400	+ 72579.0	+ 36.0	+ 7.0	+ 24.0				
10404	+ 1.01953	+ 1.07470	+ 1.09033	+ 1.11035	+ 1.12768	+ 1.14038	+ 1.16308	+ 1.17065
10414	+ 1.17504	+ 1.18969	+ 1.19335	+ 1.20117	+ 1.20214	+ 1.20117	+ 1.21020	+ 1.21191
10424	+ 1.21484	+ 1.21655	+ 1.21972	+ 1.22143	+ 1.23242	+ 1.22656	+ 1.22094	+ 1.21459
10434	+ 1.23217	+ 1.22729	+ 1.22363	+ 1.22387	+ 1.21411	+ 1.21728	+ 1.21337	+ 1.20996
10444	+ 1.20532	+ 1.18701	+ 1.18408	+ 1.17626	+ 1.15454	+ 1.14843	+ 1.13281	+ 1.13110
10454	+ 1.11816	+ 1.11450	+ 1.09790	+ 1.08715	+ 1.08447	+ 1.06860	+ 1.06127	+ 1.05273
10464	+ 1.04272	+ 1.04223	+ 1.00463					
10467	+ 72819.0	+ 36.0	+ 7.0	+ 10.0				
10473	+ 1.01831	+ 1.07421	+ 1.08520	+ 1.10522	+ 1.13037	+ 1.13696	+ 1.15161	+ 1.15698
10503	+ 1.16699	+ 1.17944	+ 1.18872	+ 1.19213	+ 1.19921	+ 1.18457	+ 1.20385	+ 1.20874
10513	+ 1.21093	+ 1.20751	+ 1.19921	+ 1.21557	+ 1.21191	+ 1.21899	+ 1.20996	+ 1.20874
10523	+ 1.21191	+ 1.21850	+ 1.21923	+ 1.21728	+ 1.20532	+ 1.21826	+ 1.20117	+ 1.20190
10533	+ 1.18945	+ 1.17407	+ 1.17358	+ 1.16723	+ 1.14868	+ 1.13696	+ 1.12231	+ 1.11914
10543	+ 1.11157	+ 1.10473	+ 1.09643	+ 1.07470	+ 1.08300	+ 1.06738	+ 1.06225	+ 1.04858
10553	+ 1.04052	+ 1.04174	+ 1.00439					
10560	+ 18.0	+ .0	+ .0					
RFD 10000/411/3/								
10000	+ 73119.0	+ 36.0	+ 7.0	+ 11.0				
10004	+ 1.01977	+ 1.07299	+ 1.08862	+ 1.09814	+ 1.13330	+ 1.14428	+ 1.15917	+ 1.16699
10014	+ 1.17138	+ 1.18188	+ 1.19677	+ 1.19921	+ 1.20312	+ 1.19506	+ 1.21459	+ 1.22021
10024	+ 1.22070	+ 1.21752	+ 1.20385	+ 1.22290	+ 1.22875	+ 1.23364	+ 1.22387	+ 1.21533
10034	+ 1.23193	+ 1.22827	+ 1.23193	+ 1.22290	+ 1.21411	+ 1.21728	+ 1.21752	+ 1.21508
10044	+ 1.20678	+ 1.18554	+ 1.19970	+ 1.18579	+ 1.17700	+ 1.17065	+ 1.14672	+ 1.15527
10054	+ 1.13745	+ 1.13623	+ 1.11572	+ 1.10473	+ 1.09960	+ 1.08496	+ 1.07080	+ 1.05957
10064	+ 1.04663	+ 1.04907	+ 1.00415					
10067	+ 73419.0	+ 36.0	+ 7.0	+ 30.0				
10073	+ 1.02026	+ 1.06347	+ 1.08593	+ 1.09741	+ 1.12524	+ 1.13745	+ 1.14501	+ 1.15942
10103	+ 1.16455	+ 1.17919	+ 1.18847	+ 1.19409	+ 1.18701	+ 1.18847	+ 1.20678	+ 1.20898
10113	+ 1.22045	+ 1.20654	+ 1.20678	+ 1.21508	+ 1.22558	+ 1.21948	+ 1.21313	+ 1.20825
10123	+ 1.22021	+ 1.21801	+ 1.21948	+ 1.21777	+ 1.20874	+ 1.21752	+ 1.21264	+ 1.20434
10133	+ 1.20190	+ 1.17480	+ 1.17822	+ 1.16894	+ 1.16088	+ 1.13452	+ 1.12646	+ 1.11987
10143	+ 1.11450	+ 1.10522	+ 1.09057	+ 1.07983	+ 1.07934	+ 1.06616	+ 1.05859	+ 1.04663
10153	+ 1.03979	+ 1.03735	+ 1.00585					
10160	+ 20.0	+ .0	+ .0					

RFD 10000/406/3/

10000	+ 71559.0	+ 36.0	+ 7.0	+ 18.0				
10004	+ 1.01440	+ 1.04418	+ 1.05371	+ 1.06372	+ 1.07617	+ 1.08056	+ 1.08764	+ 1.09301
10014	+ 1.09790	+ 1.11059	+ 1.11108	1.11718	+ 1.11718	+ 1.12182	+ 1.12866	+ 1.12597
10024	+ 1.12792	+ 1.12963	+ 1.13159	+ 1.13525	+ 1.13793	+ 1.13208	+ 1.12524	+ 1.12207
10034	+ 1.13208	+ 1.13525	+ 1.13232	+ 1.13281	+ 1.12280	+ 1.13330	+ 1.11962	+ 1.11938
10044	+ 1.11767	+ 1.10131	+ 1.10034	+ 1.09301	+ 1.08740	+ 1.07739	+ 1.06591	+ 1.06665
10054	+ 1.06225	+ 1.05688	+ 1.05175	+ 1.04370	+ 1.04101	+ 1.03906	+ 1.03100	+ 1.02783
10064	+ 1.02246	+ 1.02441	+ 1.00415					
10067	+ 71799.0	+ 36.0	+ 7.0	+ 10.0				
10073	+ 1.02050	+ 1.07885	+ 1.09521	+ 1.11303	+ 1.13549	+ 1.15698	+ 1.16479	+ 1.16333
10103	+ 1.17773	+ 1.18823	+ 1.19897	+ 1.20263	+ 1.19653	+ 1.20751	+ 1.21459	+ 1.22729
10113	+ 1.23071	+ 1.22094	+ 1.21679	+ 1.22753	+ 1.22924	+ 1.23388	+ 1.22924	+ 1.22753
10123	+ 1.23339	+ 1.22729	+ 1.23022	+ 1.23095	+ 1.21386	+ 1.22875	+ 1.21606	+ 1.21020
10133	+ 1.20507	+ 1.18676	+ 1.19628	+ 1.17529	+ 1.16381	+ 1.14599	+ 1.13208	+ 1.13085
10143	+ 1.12841	+ 1.11132	+ 1.10351	+ 1.08496	+ 1.08813	+ 1.07519	+ 1.06005	+ 1.05224
10153	+ 1.04394	+ 1.04394	+ 1.00366					
10160	+ 14.0	+ .0	+ .0					
10200	+ 72039.0	+ 36.0	+ 7.0	+ 5.0				
10204	+ 1.01733	+ 1.06884	+ 1.08325	+ 1.09985	+ 1.11425	+ 1.13818	+ 1.14941	+ 1.15087
10214	+ 1.16210	+ 1.17480	+ 1.17724	+ 1.18408	+ 1.18945	+ 1.18237	+ 1.20629	+ 1.20434
10224	+ 1.20751	+ 1.20263	+ 1.20190	+ 1.21142	+ 1.20971	+ 1.21630	+ 1.21337	+ 1.20190
10234	+ 1.21118	+ 1.21630	+ 1.21484	+ 1.21191	+ 1.19897	+ 1.20629	+ 1.19628	+ 1.19116
10244	+ 1.18481	+ 1.17211	+ 1.16406	+ 1.16259	+ 1.14599	+ 1.12817	+ 1.11865	+ 1.11450
10254	+ 1.10449	+ 1.10156	+ 1.08471	+ 1.07641	+ 1.06616	+ 1.06127	+ 1.05590	+ 1.04418
10264	+ 1.03686	+ 1.03515	+ 1.00463					
10267	+ 72279.0	+ 36.0	+ 7.0	+ 17.0				
10273	+ 1.02148	+ 1.07202	+ 1.09350	+ 1.11401	+ 1.13403	+ 1.14794	+ 1.16430	+ 1.16601
10303	+ 1.17822	+ 1.19409	+ 1.19409	+ 1.20166	+ 1.20971	+ 1.20068	+ 1.21948	+ 1.22729
10313	+ 1.21679	+ 1.22656	+ 1.21289	+ 1.22656	+ 1.22875	+ 1.24462	+ 1.23535	+ 1.22070
10323	+ 1.23535	+ 1.23388	+ 1.23071	+ 1.22485	+ 1.22119	+ 1.23144	+ 1.22119	+ 1.22607
10333	+ 1.21313	+ 1.19824	+ 1.20507	+ 1.20117	+ 1.18945	+ 1.17993	+ 1.16577	+ 1.15917
10343	+ 1.15405	+ 1.14379	+ 1.13232	+ 1.11181	+ 1.10766	+ 1.09741	+ 1.08105	+ 1.06591
10353	+ 1.05200	+ 1.05126	+ 1.00537					
10360	+ 16.0	+ .0	+ .0					

RFD 10000/414/3/

10000	+ 74679.0	+ 36.0	+ 7.0	+ 29.0				
10004	+ 1.01635	+ 1.06005	+ 1.07690	+ 1.09643	+ 1.10717	+ 1.11621	+ 1.12988	+ 1.14038
10014	+ 1.14721	+ 1.15234	+ 1.15844	+ 1.17358	+ 1.17016	+ 1.17138	+ 1.16772	+ 1.18847
10024	+ 1.18310	+ 1.18603	+ 1.17333	+ 1.19433	+ 1.19628	+ 1.19897	+ 1.19555	+ 1.17456
10034	+ 1.19360	+ 1.19628	+ 1.20141	+ 1.18896	+ 1.18334	+ 1.18750	+ 1.18920	+ 1.18505
10044	+ 1.17041	+ 1.14306	+ 1.15625	+ 1.14550	+ 1.13061	+ 1.11791	+ 1.10717	+ 1.11059
10054	+ 1.09277	+ 1.09204	1.08691	+ 1.07543	+ 1.06860	+ 1.06030	+ 1.05224	+ 1.04614
10064	+ 1.03588	+ 1.03588	+ 1.00366					
10067	+ 74979.0	+ 36.0	+ 7.0	+ 10.0				
10073	+ 1.01855	+ 1.06250	+ 1.07373	+ 1.08642	+ 1.10937	+ 1.11987	+ 1.12500	+ 1.13696
10103	+ 1.14184	+ 1.15209	+ 1.16064	+ 1.15942	+ 1.16894	+ 1.15991	+ 1.17016	+ 1.18310
10113	+ 1.18139	+ 1.18457	+ 1.17919	+ 1.18334	+ 1.18164	+ 1.18481	+ 1.17675	+ 1.16992
10123	+ 1.18286	+ 1.18725	+ 1.18872	+ 1.18725	+ 1.16845	+ 1.17382	+ 1.17333	+ 1.16821
10133	+ 1.16455	+ 1.14672	+ 1.15063	+ 1.14428	+ 1.12963	+ 1.12011	+ 1.10888	+ 1.11010
10143	+ 1.09667	+ 1.08911	+ 1.08666	+ 1.07031	+ 1.06762	+ 1.06127	+ 1.05004	+ 1.04125
10153	+ 1.03881	+ 1.03613	+ 1.00390					
10160	+ 26.0	+ .0	+ .0					
10200	+ 75279.0	+ 36.0	+ 7.0	+ 27.0				
10204	+ 1.01928	+ 1.06176	+ 1.07910	+ 1.08984	+ 1.11181	+ 1.11743	+ 1.13598	+ 1.14086
10214	+ 1.14477	+ 1.15600	+ 1.15405	+ 1.16406	+ 1.15576	+ 1.17578	+ 1.17895	+ 1.18579
10224	+ 1.18530	+ 1.17285	+ 1.17626	+ 1.19042	+ 1.18481	+ 1.18017	+ 1.19042	+ 1.18627
10234	+ 1.20263	+ 1.19140	+ 1.19091	+ 1.18872	+ 1.17968	+ 1.19262	+ 1.18481	+ 1.17871
10244	+ 1.16650	+ 1.16503	+ 1.15600	+ 1.16040	+ 1.14721	+ 1.13159	+ 1.12719	+ 1.12792
10254	+ 1.11450	+ 1.10498	+ 1.10131	+ 1.08349	+ 1.07714	+ 1.07299	+ 1.05908	+ 1.04785
10264	+ 1.04125	+ 1.03979	+ 1.00463					
10267	+ 75639.0	+ 36.0	+ 7.0	+ 26.0				
10273	+ 1.01635	+ 1.06030	+ 1.06835	+ 1.09179	+ 1.10595	+ 1.11767	+ 1.12744	+ 1.13061
10303	+ 1.13940	+ 1.14697	+ 1.15307	+ 1.15747	+ 1.16064	+ 1.15380	+ 1.17407	+ 1.17065
10313	+ 1.17187	+ 1.16406	+ 1.16748	+ 1.16528	+ 1.17456	+ 1.18212	+ 1.17407	+ 1.16845
10323	+ 1.17456	+ 1.17358	+ 1.17578	+ 1.16699	+ 1.16845	+ 1.17163	+ 1.17211	+ 1.16870
10333	+ 1.16064	+ 1.14794	+ 1.14868	+ 1.12329	+ 1.12988	+ 1.11572	+ 1.10375	+ 1.09838
10343	+ 1.09838	+ 1.08935	+ 1.07983	+ 1.07104	+ 1.06542	+ 1.06054	+ 1.04711	+ 1.04174
10353	+ 1.03540	+ 1.03662	+ 1.00439					
10360	+ 28.0	+ .0	+ .0					

10200	+ 76899.0	+ 36.0	+ 5.0	+ 22.0				
10204	+ 1.01611	+ 1.05468	+ 1.07104	+ 1.07641	+ 1.09350	+ 1.10253	+ 1.11279	+ 1.12133
10214	+ 1.12329	+ 1.13720	+ 1.13867	+ 1.13964	+ 1.14111	+ 1.14331	+ 1.16137	+ 1.15649
10224	+ 1.15747	+ 1.16137	+ 1.15844	+ 1.17211	+ 1.16235	+ 1.16772	+ 1.17089	+ 1.15771
10234	+ 1.16772	+ 1.16894	+ 1.17114	+ 1.16186	+ 1.15014	+ 1.16333	+ 1.16088	+ 1.15356
10244	+ 1.15771	+ 1.15136	+ 1.15405	+ 1.14770	+ 1.14428	+ 1.13378	+ 1.12695	+ 1.12573
10254	+ 1.11987	+ 1.10986	+ 1.10449	+ 1,09033	+ 1.08496	+ 1.07641	+ 1.06054	+ 1.05053
10264	+ 1.04003	+ 1.03857	+ 1.00439					
10267	+ 77139.0	+ 36.0	+ 5.0	+ 10.0				
10273	+ 1.01538	+ 1.05639	+ 1.06494	+ 1.07543	+ 1.09350	+ 1.10327	+ 1.11279	+ 1.12036
10303	+ 1.11889	+ 1.13159	+ 1.13525	+ 1.14208	+ 1.13964	+ 1.14038	+ 1.15136	+ 1.16015
10313	+ 1.15502	+ 1.15283	+ 1,15356	+ 1.15869	+ 1.16015	+ 1.16162	+ 1.15551	+ 1.15332
10323	+ 1.15649	+ 1.15429	+ 1.15869	+ 1.15820	+ 1.15063	+ 1.15649	+ 1.14868	+ 1.15087
10333	+ 1.14038	+ 1.13085	+ 1.12524	+ 1.12036	+ 1.10888	+ 1.09790	+ 1.09252	+ 1.08837
10343	+ 1.08374	+ 1.07641	+ 1.07153	+ 1.06005	+ 1.05590	+ 1.04882	+ 1.04077	+ 1.03686
10353	+ 1.02832	+ 1.03369	+ 1.00415					
10360	+ 34.0	+ .0	+ .0					
10400	+ 77379.0	+ 36.0	+ 5.0	+ 8.0				
10404	+ 1.01635	+ 1.05371	+ 1.06689	+ 1.07910	+ 1.09106	+ 1.10107	+ 1.10839	+ 1.12255
10414	+ 1.12304	+ 1.12817	+ 1.13623	+ 1.13647	+ 1.14135	+ 1.14013	+ 1.15087	+ 1.14941
10424	+ 1.15087	+ 1.14916	+ 1.14892	+ 1.15478	+ 1.15576	+ 1.15136	+ 1.15356	+ 1.15576
10434	+ 1.15454	+ 1.15722	+ 1.16406	+ 1.15600	+ 1.13964	+ 1.14697	+ 1.15136	+ 1.15014
10444	+ 1.13623	+ 1.13745	+ 1.13037	+ 1.13305	+ 1.11450	+ 1.11035	+ 1.09912	+ 1.09960
10454	+ 1.09350	+ 1.08789	+ 1.07690	+ 1,06909	+ 1.06445	+ 1.05493	+ 1.04541	+ 1.04125
10464	+ 1.03393	+ 1.03393						
10467	+ 77619.0	+ 36.0	+ 5.0	+ 12.0				
10473	+ 1.01538	+ 1.05151	+ 1.06738	+ 1.07617	+ 1.09301	+ 1.10302	+ 1.11425	+ 1.11645
10503	+ 1.12231	+ 1.12841	+ 1.13940	+ 1.14160	+ 1.14721	+ 1.13769	+ 1.15087	+ 1.15429
10513	+ 1.15283	+ 1.15576	+ 1.15527	+ 1.15698	+ 1.15820	+ 1.16040	+ 1.16528	+ 1.15722
10523	+ 1.16943	+ 1.16162	+ 1.16064	+ 1.16113	+ 1.15185	+ 1.15844	+ 1.15966	+ 1.15795
10533	+ 1.14721	+ 1.13989	+ 1.14135	+ 1.13208	+ 1.12426	+ 1.11962	+ 1.11157	+ 1.10302
10543	+ 1.10253	+ 1.09179	+ 1.08959	+ 1.07812	+ 1.07153	+ 1.06201	+ 1.05200	+ 1.04125
10553	+ 1.03320	+ 1.03588	+ 1.00390					
10560	+ 36.0	+ .0	+ .0					

RFD 10000/422/3/

10000	+ 77859.0	+ 36.0	+ 5.0	+ 10.0				
10004	+ 1.01538	+ 1.05102	+ 1.06372	+ 1.07617	+ 1.08740	+ 1.09472	+ 1.10644	+ 1.11206
10014	+ 1.11914	+ 1.12475	+ 1.12646	+ 1.13305	+ 1.13061	+ 1.13281	+ 1.14477	+ 1.14038
10024	+ 1.14648	+ 1.14379	+ 1.14062	+ 1.14575	+ 1.15527	+ 1.14941	+ 1.14770	+ 1.14160
10034	+ 1.15527	+ 1.14770	+ 1.14868	+ 1.14648	+ 1.13867	+ 1.14868	+ 1.14477	+ 1.13940
10044	+ 1.12890	+ 1.12573	+ 1.12255	+ 1.11328	+ 1.10400	+ 1.09692	+ 1.08544	+ 1.08813
10054	+ 1.07983	+ 1.07275	+ 1.06518	+ 1.05615	+ 1.05273	+ 1.04833	+ 1.04467	+ 1.03393
10064	+ 1.03173	+ 1.02905	+ 1.00415					

10160	+ 37.0	+ .0	+ .0

ADDENDUM

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INTRODUCTION

The results of measurements by means of the Aeroball System up to Aeroball Run No. 42 have been presented in the ENEL Report "Neutron Flux Distributions During First Operating Cycle of Trino V. Reactor".

In this Addendum, the results from A. R. 's No. 42 to 55(i. e. the last run that was performed during the first operating cycle of the Trino plant) are presented and analyzed.

Table 1e gives the significant plant operating data for each A. R. considered.

1. AEROBALL DATA ANALYSIS

The Aeroball data were corrected and analyzed by means of the methods described in the above mentioned report. In particular, the integrated activities were normalized for each A. R. to Aeroball 19.

For A. R. 's 42A and 43B the absolute activities, expressed in microamperes, were compared. These activities were referred to the same measuring conditions by multiplying the integrated activities of A. R. 42A by S_{43B}/S_{42A}, the ratio of the source readings taken at the beginning of the performance of the runs. Power levels and irradiation times were the same for the two A. R. 's.

Activity axial distributions from different runs were compared by means of the normalization method described in the report (ref. 2. 4. 3).

The two Aeroballs analyzed for each run are Aeroballs 7 and 20, which are respectively located at the core periphery and at the core center.

2. PRESENTATION OF THE RESULTS

2.1 Activity variation in an Aeroball as function of irradiation

Tables 3e to 3t give the data from A. R.'s 42 to 55. The fifth column of each table shows the activity values referred to Aeroball 19. The same values are plotted in Figs. 1A to 1H. Each section of these figures contains data from octant-symmetrical Aeroballs, and shows the activity curve calculated on a theoretical basis by FIAT, along with the experimental points from the pre - ceeding runs, already given in the report (ref. Figs. 5A to 5F). Besides giving the trend of the activities referred to Aeroball 19 at the end of the first core life, these figures permit to assess the system reproducibility and to detect differences between ball sets A and B, since the respective set for each experimental point is identified.

2.2 Radial distribution

The map in Fig. 2 gives a comparison of the absolute activities, expressed as μA, from A. R. 42A, that was performed at normal conditions and 43B, that was performed after a decrease in coolant average temperature from 276 to 261 ^{o}C.

The activities rise at the core periphery and decrease in the middle and inner regions, while the average temperature decreases.

The map in Fig. 4D gives the integrated activities normalized to Aeroball 19 at the irradiation level of 11,492 MWD/MTU, at which level A. R. 51B was performed. A. R. 51B is the last run performed at nominal power during the first operating cycle. The activities at the core periphery reach the highest values of the whole cycle, following the trend already noticed in the previous maps (ref. Figs. 4A to 4C of the report).

No appreciable trends in activity radial distributions have been noticed as far as changes in power level and xenon distribution were concerned.

2.3 Axial distribution

For runs performed at normal operating conditions and with control rods withdrawn , the maximum/average axial ratio is always less than 1.16, following the trend already noticed in Fig. 9 of the report.

The maximum/average ratio for run 43B that was performed at low coolant temperature rises up to 1.24.

Runs performed at low power level give ratios up to 1.3.
Figs. 5A to 5E show the effect on the axial activity distribution of a decrease in coolant average temperature and in power level, and of a xenon transient after control rod insertion.

Figs. 5A and 5B show a comparison of Aeroball 7 and 20 from A. R. 's 42A and 43B. One can notice the slight peak towards the core top.

Figs. 5C and 5D show the profiles relating to Aeroball 7 and 20 from A. R. 51B that was performed at full power and 55B that was performed at 80 MW(e). The irradiation level is practically the same for these runs. While the profiles from A. R. 51B are flattened, the profiles from A. R. 55B show a peak towards the core top. One can also notice that the profiles of different Aeroballs from the same run are practically identical.

Fig. 5E shows the activity profiles of Aeroball 20 from A. R. 46A, which was performed 3 hours after a control rod insertion down to 220 steps, and A. R. 47B that was performed 30 hours later with no control rod movement in the meanwhile. The xenon distribution reduces the skewing towards the core bottom due to the control rod insertion.

3. SYSTEM ERROR ANALYSIS

The analysis of the errors of the Aeroball system has been carried on.

A precise analysis of ball composition showed that the manganese concentration is non-uniform from one ball to another, confirming the assumption already made about wrinkling (ref. 4. 7 of the report).

The system reproducibility was assessed by means of a study of Figs. 1A to 1H. These figures show experimental data obtained within a short time interval and at comparable measuring conditions. As one can see, the experimental points are comparised within $\pm$ 2%. The activities are practically affected by the same error no matter which set of balls is used. Greater differences can be noticed between experimental points from A. R. 's 42A and 43B due to the different coolant average temperatures.

SUMMARY AND CONCLUSIONS

1. The plant was operated during the first 2600 MWD/MTU at the power level of 600 MW(t) with the 10 rods of the Control Group inserted by 30-40 % and with the 2 rods of the Trim Group inserted by approximately 50%.

   During the remaining length of the first cycle, the plant was operated at 825 MW(t) with the control rods practically out of the core except for short time intervals.

2. The integrated activities of the fuel assemblies located at the periphery of the core increased during the first cycle by approximately 8-12% compared to the activity in the reference fuel element (Aeroball 19) located in the intermediate region of the core. The activities in the assemblies comprising the central and intermediate regions did not show any significant change compared to the reference fuel assembly.

3. The early plant operation with control rod partially inserted caused a skewing of the axial flux distribution towards the bottom of the core and consequently a smaller burn-up in the upper core region. Thus, during the subsequent operating period with control rods out of the core, a skewing of the flux towards the core top was experienced. This skewing was then progressively eliminated along with the increase of the burn-up. At the end of the first cycle, the axial flux distribution appeared with a slight depression in the central portion of the assemblies.

   The axial maximum/average ratio decreased steadily with burn-up down to approximately 1.15 at the end of the cycle, in normal operating conditions.

4. At the end of the first cycle, the coolant average temperature was reduced during a special test from 276 to 261 ^{o}C. Subsequently to the temperature reduction, the following phenomena were observed:

   a. The axial activity profiles showed a skewing towards the top of the core with a peak located at 1/5 of the active core length. The maximum /

average ratio increased up to 1. 24 for the assemblies of the central region.

b. The radial activity distribution showed an average increase of 3% in the assemblies located near the periphery of the core.

5. At the end of the first cycle, the power level was reduced from 255 to 80 MW(e) without control rod movement.

The axial activity profiles showed a skewing towards the top of the core similarly to that described in paragraph 4a above but more pronounced. The maximum/average ratio increased up to 1. 31.

No trends have been observed in the radial activity distribution following the power change.

6. The accuracy of the Aeroball System during the early phase of the first cycle could not be systematically assessed. At the end of the cycle, a repeatibility test was conducted covering 13 A. R. 's.

All the experimental points fell within a ± 2% band.

ENEL

TABLE 1e — SUMMARY OF AEROBALL RUNS

DATE: June - 7 - '67

Comp.: G B | App.: S V

A. R.	DATE	STARTING TIME FOR IRRADIATION	IRRADIATION TIME	AEROBALLS NOT WORKING	ELECTRICAL POWER HISTORY DURING LAST 3 DAYS	IRRADIATION LEVEL	CONTROL GROUP POSITION DURING LAST 3 DAYS	BORON CONCENTRATION
			MINUTES		MW(e)	MWD/MTU	STEPS	ppm
42 A	9-3-1967	10.56	10	1-8-9-16-25-28	constant at 255	10763	constant at 263	60
43 B	9-3-1967	20,22	10	1-8-9-16-22-25-28	constant at 255	10771	constant at 263	133
44 A	14-3-1967	11,45	20	1-9-10-16-25	constant at 255	10869	263 until 3 pm on March 13 th 279 until 10 am on March 14 th 286 at measure	54
45 B	16-3-1967	09,50	20	1-9-22-25	constant at 255	10909	see A.R. 44 A 286 at measure	53
46 A	16-3-1967	16,40	20	1-8-9-16-25	constant at 250	10915	286 until 1 pm on March 16 th 220 at measure	53
47 B	17-3-1967	20,25	20	1-9-14-22-25-28	constant at 255	10938	see A.R. 46 A 220 at measure	53
48 A	5-4-1967	11,33	20	1-8-9-25	constant at 255	11270	271 until 1pm on April 3 th 279 until 1am on April 4 th 286 at measure	4
49 B	12-4-1967	11,42	20	1-8-9-22-25	constant at 251	11447	262 until 5 pm on April 10 th 278 until 6 pm on April 11 th 286 at measure	1.7
50 A	14-4-1967	11,30	20	1-8-9-25	constant at 251	11488	constant at 286	2.3
51 B	14-4-1967	16,05	20	1-9-14-22-25	constant at 251	11492	constant at 286	2.3
52 A	17-4-1967	15,08	20	1-8-9-25	251 until 01 am on April 15 th 86 at measure	11515	constant at 286	181
53 B	18-4-1967	9,33	20	1-9-14-22-25	constant at 80	11520	constant at 286	200
54 A	27-4-1967	9,19	20	1-8-9-23-25	constant at 80	11580	constant at 286	194
55 B	28-4-1967	9,40	20	1-9-14-22-25	constant at 80	11586	constant at 286	190

ENEL	Table 3e A.R. # 42 A **10763** MWD/MTU
Data: 24-4-67	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: / Verificato: SV	

J	$\int_0^{104.6} I_{Jn} = I_J$ $[\mu A]$	C_J	$I_{JC} = \frac{I_J}{C_J}$ $[\mu A]$	$\frac{I_{JC}}{I_{19C}}$	
1	out	—	—	—	
2	3,070	1,020	3,010	0,599	
3	2,958	1,011	2,926	0,583	
4	2,575	1,008	2,555	0.509	
5	4,735	1,029	4,602	0,916	
6	3,975	1,025	3,877	0,770	
7	2,543	1,005	2,530	0,504	
8	out	—	—	—	
10	4,934	1,033	4,776	0,951	
11	5,254	1,042	5,042	1,004	
12	5,306	1,043	5,087	1,013	
13	5,083	1,036	4,906	0,977	
14	4,754	1,031	4,611	0,918	
15	5,253	1,039	5,056	1,007	
16	out	—	—	—	
17	5,235	1,041	5,029	1,001	
18	3,000	1,018	2,947	0,587	
19	5,222	1,040	5,021	1,000	
20	5,110	1,014	5,040	1,004	
21	4,710	1,026	4,591	0,914	
22	5,216	1,044	4,996	0,995	
23	2,910	1,016	2,864	0,570	
24	5,139	1,035	4,965	0,989	
25	out	—	—	—	
26	5,232	1,037	5,045	1,005	
27	5,340	1,044	5,115	1,019	
28	out	—	—	—	
29	5,092	1,041	4,892	0,974	
30	5,308	1,043	5,089	1,013	

ENEL	Table 3f A.R. 43B 10771 MWD/MTU
Data: 2 - 5 - 67	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	–	–	–	
2	3,184	1,010	3,152	0,618	
3	2,982	1,003	2,973	0,583	
4	2,671	1,002	2,665	0,523	
5	4,776	1,018	4,691	0,920	
6	4,166	1,014	4,108	0,806	
7	2,666	1,001	2,663	0,522	
8	out	–	–	–	
10	5,090	1,021	4,985	0,978	
11	5,313	1,030	5,158	1,012	
12	5,262	1,030	5,108	1,002	
13	5,201	1,024	5,079	0,996	
14	out	–	–	–	
15	5,259	1,026	5,125	1,005	
16	out	–	–	–	
17	5,235	1,029	5,087	0,998	
18	3,147	1,008	3,122	0,612	
19	5,238	1,028	5,095	1,000	
20	5,092	1,004	5,071	0,995	
21	4,880	1,016	4,803	0,942	
22	out	–	–	–	
23	3,052	1,006	3,033	0,595	
24	5,142	1,022	5,031	0,987	
25	out	–	–	–	
26	5,101	1,025	4,976	0,976	
27	5,400	1,030	5,242	1,028	
28	out	–	–	–	
29	5,186	1,028	5,044	0,989	
30	5,334	1,030	5,178	1,016	

ENEL	Table 39 A.R. 44A 10869 MWD/MTU
Data: 3 - 5 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	5.84	1,015	5,76	0,604	
3	5,60	1,007	5,57	0,583	
4	4,90	1,005	4,87	0,510	
5	8,90	1,024	8,68	0,910	
6	7,53	1,018	7,40	0,775	
7	4,88	1,002	4,87	0,510	
8	9,45	1,026	9,22	0,965	
10	out	—	—	—	
11	9,94	1,036	9,60	1,005	
12	9,98	1,037	9,64	1,010	
13	9,78	1,030	9,50	0,995	
14	8,95	1,025	8,73	0,915	
15	10,00	1,032	9,70	1,015	
16	out	—	—	—	
17	9,85	1,035	9,53	0,997	
18	5,84	1,013	5,77	0,604	
19	9,86	1,033	9,55	1,000	
20	9,64	1,009	9,57	1,002	
21	8,93	1,021	8,73	0,915	
22	9,80	1,038	9,45	0,989	
23	5,43	1,011	5,37	0,562	
24	9,72	1,029	9,46	0,990	
25	out	—	—	—	
26	9,70	1,031	9,42	0,985	
27	10,06	1,038	9,70	1,016	
28	7,98	1,020	7,83	0,820	
29	9,68	1,035	9,36	0,980	
30	10,03	1,037	9,68	1,015	

ENEL	Table 3h A.R. 45 B 10909 MWD/MTU
Data: 5 - 5 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	5,84	1,027	5,69	0,606	
3	5,54	1,021	5,42	0,576	
4	4,97	1,020	4,87	0,518	
5	8,84	1,032	8,56	0,910	
6	7,60	1,028	7,40	0,787	
7	4,87	1,004	4,85	0,516	
8	9,15	1,007	9,10	0,966	
10	9,21	1,010	9,12	0,970	
11	9,70	1,013	9,57	1,018	
12	9,73	1,016	9,58	1,019	
13	9,72	1,035	9,40	1,000	
14	8,86	1,034	8,57	0,911	
15	9,85	1,038	9,50	1,010	
16	9,77	1,039	9,41	1,000	
17	9,77	1,040	9,40	1,000	
18	5,82	1,026	5,68	0,604	
19	9,74	1,038	9,40	1,000	
20	9,65	1,018	9,48	1,009	
21	8,94	1,031	8,68	0,923	
22	out	—	—	—	
23	5,63	1,023	5,49	0,584	
24	9,56	1,035	9,24	0,983	
25	out	—	—	—	
26	9,63	1,037	9,30	0,988	
27	9,99	1,041	9,60	1,020	
28	7,95	1,030	7,72	0,821	
29	9,66	1,040	9,28	0,987	
30	9,86	1,041	9,48	1,009	

ENEL	Table 3i A.R. 46 A 10951 MWD/MTU
Data: 8 - 5 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: / Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ $[\mu A]$	C_J	$I_{Jc} = \frac{I_J}{C_J}$ $[\mu A]$	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	5,25	1,009	5,21	0,607	
3	5,04	1,004	5,02	0,586	
4	4,47	1,003	4,46	0,520	
5	7.90	1,016	7,79	0,908	
6	6,84	1,012	6,75	0,788	
7	4,46	1,001	4,45	0,518	
8	out	—	—	—	
10	8,36	1,020	8,20	0,957	
11	8,90	1,022	8,72	1,016	
12	8.96	1,022	8,79	1,025	
13	8,66	1,020	8,49	0,990	
14	8,06	1,017	7,94	0,926	
15	8,75	1.021	8.57	1,000	
16	out	—	—	—	
17	8,82	1,021	8,63	1.008	
18	5.20	1,008	5,17	0,603	
19	8,75	1,021	8,57	1,000	
20	8,67	1,005	8,63	1,008	
21	8.04	1,014	7,93	0,925	
22	8,84	1,022	8,64	1,008	
23	5,06	1,007	5.03	0,586	
24	8,68	1,020	8.50	0,993	
25	out	—	—	—	
26	8,58	1,021	8,40	0,981	
27	9,00	1,022	8,81	1,027	
28	7,35	1,013	7,25	0,845	
29	8,52	1,021	8,35	0,973	
30	8,87	1,022	8,69	1,015	

ENEL	Table 3 l A.R. 47 B 10938 MWD/MTU
Data: 9 - 5 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	5,18	1,006	5,15	0,605	
3	4,94	1,003	4,93	0,578	
4	4,48	1,002	4,47	0,525	
5	7,85	1,011	7,76	0,911	
6	6,82	1,007	6,77	0,795	
7	4,42	1,001	4,42	0,518	
8	8,27	1,012	8,18	0,958	
10	8,34	1,014	8,22	0,964	
11	8,86	1,025	8,65	1,015	
12	8,79	1,027	8,57	1,005	
13	8,61	1,016	8,49	0,995	
14	out	—	—	—	
15	8,66	1,019	8,50	0,998	
16	8,77	1,021	8,60	1,010	
17	8,94	1,023	8,71	1,023	
18	5,16	1,005	5,14	0,604	
19	8,69	1,020	8,52	1,000	
20	8,64	1,003	8,59	1,008	
21	7,90	1,009	7,83	0,918	
22	out	—	—	—	
23	5,01	1,004	4,98	0,584	
24	8,46	1,015	8,34	0,979	
25	out	—	—	—	
26	8,40	1,018	8,26	0,974	
27	8,91	1,028	8,66	1,017	
28	out	—	—	—	
29	8,58	1,022	8,40	0,985	
30	8,75	1,026	8,53	1,001	

ENEL		Table 3m A.R. 48 A 11270 MWD/MTU
Data: 11 - 5 - 1967		Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato:	Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	–	–	–	
2	5,82	1,008	5,774	0,610	
3	5,53	1,003	5,513	0,583	
4	4,83	1,002	4,820	0,509	
5	8,84	1,020	8,667	0,916	
6	7,48	1,012	7,391	0,781	
7	4,87	1,001	4,865	0,514	
8	out	–	–	–	
10	9,47	1,043	9,080	0,960	
11	9,93	1,039	9,557	1,010	
12	10,00	1,042	9,597	1,015	
13	9,69	1,029	9,417	0,996	
14	8,93	1,024	8,721	0,922	
15	9,85	1,032	9,544	1,009	
16	11,47	1,036	11,070	1,170	
17	9,83	1,039	9,460	1,002	
18	5,79	1,007	5,750	0,608	
19	9,78	1,034	9,458	1,000	
20	9,50	1,004	9,462	1,000	
21	8,87	1,016	8,730	0,923	
22	9,83	1,043	9,425	0,996	
23	5,50	1,006	5,467	0,578	
24	9,62	1,026	9,376	0,991	
25	out	–	–	–	
26	9,62	1,031	9,331	0,986	
27	10,13	1,042	9,722	1,028	
28	8,06	1,014	7,949	0,840	
29	9,69	1,038	9,335	0,987	
30	10,04	1,040	9,654	1,021	

ENEL	Table 3n A.R. 49B 11447 MWD/MTU
Data: 12 - 5 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	5,72	1,011	5,68	0,609	
3	5,45	1,005	5,41	0,581	
4	4,85	1,003	4,83	0,518	
5	8,68	1,020	8,50	0,910	
6	7,42	1,014	7,34	0,787	
7	4,83	1,002	4,81	0,516	
8	out	—	—	—	
10	9,22	1,028	8,96	0,960	
11	9,84	1,047	9,40	1,008	
12	9,91	1,049	9,45	1,012	
13	9,59	1,030	9,31	0,998	
14	out	—	—	—	
15	9,76	1,035	9,42	1,009	
16	9,67	1,039	9,33	1,000	
17	9,75	1,042	9,34	1,001	
18	5,71	1,010	5,65	0,605	
19	9,66	1,036	9,33	1,000	
20	9,34	1,007	9,28	0,995	
21	8,80	1,017	8,67	0,930	
22	out	—	—	—	
23	5,51	1,008	5,48	0,587	
24	9,39	1,029	9,12	0,979	
25	out	—	—	—	
26	9,48	1,033	9,18	0,982	
27	10,03	1,052	9,51	1,015	
28	8,00	1,016	7,92	0,850	
29	9,64	1,041	9,29	0,993	
30	9,96	1,048	9,49	1,015	

ENEL	Table 30 A.R. 50A 11488 MWD/MTU
Data: 15 - 5 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	5,64	1,013	5,56	0,615	
3	5,37	1,008	5,33	0,590	
4	4,70	1,006	4,68	0,517	
5	8,49	1,020	8,32	0,920	
6	7,25	1,015	7,14	0,789	
7	4,75	1,004	4,73	0,523	
8	out	—	—	—	
10	9,00	1,022	8,80	0,972	
11	9,40	1,031	9,12	1,008	
12	9,50	1,032	9,20	1,016	
13	9,25	1,024	9,03	0,997	
14	8,54	1,021	8,35	0,922	
15	9,32	1,026	9,10	1,005	
16	9,22	1,028	8,98	0,991	
17	9,31	1,030	9,04	0,998	
18	5,60	1,012	5,53	0,610	
19	9,30	1,027	9,06	1,000	
20	9,17	1,010	9,07	1,002	
21	8,55	1,019	8,40	0,927	
22	9,26	1,034	8,96	0,990	
23	5,27	1,011	5,21	0,575	
24	9,21	1,024	8,99	0,994	
25	out	—	—	—	
26	9,15	1,026	8,92	0,985	
27	9,62	1,033	9,30	1,028	
28	7,76	1,016	7,64	0,845	
29	9,17	1,029	8,91	0,984	
30	9,48	1,032	9,18	1,013	

ENEL	Table 3p A.R. 51 B 11492 MWD/MTU
Data: 16 - 5 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	5,58	1,004	5,50	0,608	
3	5.30	1.001	5,30	0,580	
4	4,76	1,000	4.76	0,522	
5	8,40	1,009	8,32	0,910	
6	7,25	1,005	7,20	0,789	
7	4,73	1,000	4,73	0,517	
8	8,85	1,010	8,76	0,958	
10	8,93	1,012	8,85	0,967	
11	9,46	1,025	9,23	1,010	
12	9,46	1,028	9,21	1,008	
13	9,20	1,015	9,06	0,992	
14	out	—	—	—	
15	9,34	1,019	9,15	1,002	
16	9,22	1,021	9,02	0,988	
17	9,38	1,024	9,16	1,002	
18	5,56	1,003	5,54	0,607	
19	9,31	1,020	9,14	1,000	
20	9,16	1,002	9,15	1,001	
21	8,56	1,008	8,50	0,930	
22	out	—	—	—	
23	5,50	1,034	5,32	0,582	
24	9,22	1,035	8,91	0,976	
25	out	—	—	—	
26	9,10	1,017	8,95	0,980	
27	9,60	1,029	9,33	1,020	
28	7,89	1,035	7,63	0,835	
29	9,31	1,024	9,10	0,995	
30	9,46	1,027	9,21	1,009	

ENEL	Table 3q A.R. 52 A 11515 MWD/MTU
Data: 17 - 5 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: / Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{JC} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{JC}}{I_{19C}}$	
1	out	—	—	—	
2	1,99	1,014	1,96	0,605	
3	1,90	1,007	1,89	0,583	
4	1,65	1,005	1,65	0,509	
5	3,07	1,022	3,00	0,926	
6	2,61	1,018	2,56	0,792	
7	1,66	1,002	1,66	0,513	
8	out	—	—	—	
10	3,16	1,024	3,09	0,956	
11	3,36	1,031	3,25	1,005	
12	3,36	1,032	3,25	1,005	
13	3,32	1,027	3,23	0,999	
14	3,05	1,024	2,97	0,916	
15	3,34	1,029	3,24	1,003	
16	3,27	1,030	3,17	0,980	
17	3,30	1,031	3,20	0,986	
18	1,95	1,013	1,94	0,595	
19	3,33	1,029	3,24	1,000	
20	3,25	1,009	3,22	0,995	
21	3,06	1,020	3,00	0,925	
22	3,24	1,032	3,13	0,970	
23	1,87	1,011	1,85	0,572	
24	3,30	1,026	3,22	0,995	
25	out	—	—	—	
26	3,28	1,028	3,20	0,986	
27	3,42	1,032	3,32	1,026	
28	2,76	1,019	2,71	0,838	
29	3,30	1,030	3,20	0,986	
30	3,42	1,032	3,32	1,026	

ENEL	Table 3r A.R. 53 B 11520 MWD/MTU
Data: 22 - 5 - 1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: / Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	1,82	1,003	1,81	0,612	
3	1,72	1,000	1,72	0,583	
4	1,53	1,000	1,53	0,517	
5	2,79	1,020	2,74	0,920	
6	2,40	1,005	2,38	0,803	
7	1,52	1,000	1,52	0,514	
8	2,91	1,011	2,88	0,968	
10	2,92	1,013	2,89	0,970	
11	3,03	1,020	2,98	1,000	
12	3,09	1,020	3,03	1,022	
13	3,03	1,019	2,98	1,000	
14	out	—	—	—	
15	3,04	1,020	2,99	1,006	
16	2,96	1,020	2,91	0,978	
17	2,99	1,020	2,94	0,988	
18	1,79	1,002	1,79	0,604	
19	3,03	1,020	2,98	1,000	
20	2,94	1,001	2,94	0,987	
21	2,80	1,007	2,78	0,935	
22	out	—	—	—	
23	1,74	1,001	1,74	0,588	
24	2,95	1,017	2,92	0,980	
25	out	—	—	—	
26	2,97	1,020	2,92	0,979	
27	3,12	1,020	3,07	1,030	
28	2,57	1,020	2,52	0,848	
29	3,04	1,020	2,99	1,005	
30	3,07	1,020	3,02	1,016	

ENEL	Table 3s A.R. 54 A 11580 MWD/MTU
Data: 23-5-1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	1,84	1,010	1,82	0,609	
3	1.76	1,004	1.75	0,585	
4	1.52	1,003	1.51	0,506	
5	2.82	1,015	2.79	0,931	
6	2,40	1,011	2.37	0,791	
7	1,53	1,001	1,53	0,510	
8	out	—	—	—	
10	2.93	1.016	2,89	0,963	
11	3,09	1.021	3,02	1.009	
12	3.04	1.022	2.98	0,995	
13	3,04	1,018	2.99	0.998	
14	2,82	1,015	2.78	0.927	
15	3,08	1.019	3,03	1.010	
16	2.98	1,020	2,93	0,978	
17	3,04	1.021	2,97	0,991	
18	1,81	1.008	1,80	0,600	
19	3.05	1.020	2.99	1,000	
20	2.99	1.006	2.97	0,992	
21	2.83	1.013	2,80	0,935	
22	2,98	1.023	2,92	0,974	
23	out	—	—	—	
24	3,04	1,017	2,99	1,000	
25	out	—	—	—	
26	3,04	1.018	2.99	1,000	
27	3,12	1.023	3,06	1,020	
28	2.53	1.012	2.50	0.833	
29	3,04	1,021	2.97	0,992	
30	3,12	1,022	3,06	1,021	

ENEL	Table 3t A.R. 55 B 11586 MWD/MTU
Date: 24-5-1967	Integrated Aeroball Activities Expressed as Readings of Micromicroammeter and Ratios of Integrated Activities to Activity in the Reference Aeroball.
Calcolato: Verificato:	

J	$\int_0^{104.6} I_{Jn} = I_J$ [μA]	C_J	$I_{Jc} = \frac{I_J}{C_J}$ [μA]	$\frac{I_{Jc}}{I_{19c}}$	
1	out	—	—	—	
2	1,86	1,009	1,84	0,612	
3	1,77	1,004	1,77	0,586	
4	1,56	1,003	1,55	0,515	
5	2,87	1,027	2,80	0,931	
6	2,46	1,011	2,43	0,807	
7	1,56	1,001	1,56	0,516	
8	2,98	1,017	2,93	0,973	
10	3,00	1,017	2,95	0,981	
11	3,12	1,024	3,04	1,012	
12	3,13	1,025	3,05	1,015	
13	3,08	1,020	3,01	1,000	
14	out	—	—	—	
15	3,10	1,021	3,04	1,007	
16	3,04	1,022	2,97	0,987	
17	3,07	1,024	3,00	0,996	
18	1,84	1,008	1,82	0,604	
19	3,09	1,022	3,01	1,000	
20	3,01	1,005	3,00	0,996	
21	2,86	1,013	2,82	0,938	
22	out	—	—	—	
23	1,76	1,006	1,75	0,583	
24	3,04	1,019	2,99	0,992	
25	out	—	—	—	
26	3,04	1,020	2,99	0,992	
27	3,15	1,026	3,07	1,020	
28	2,58	1,027	2,51	0,834	
29	3,10	1,023	3,04	1,007	
30	3,15	1,025	3,07	1,020	

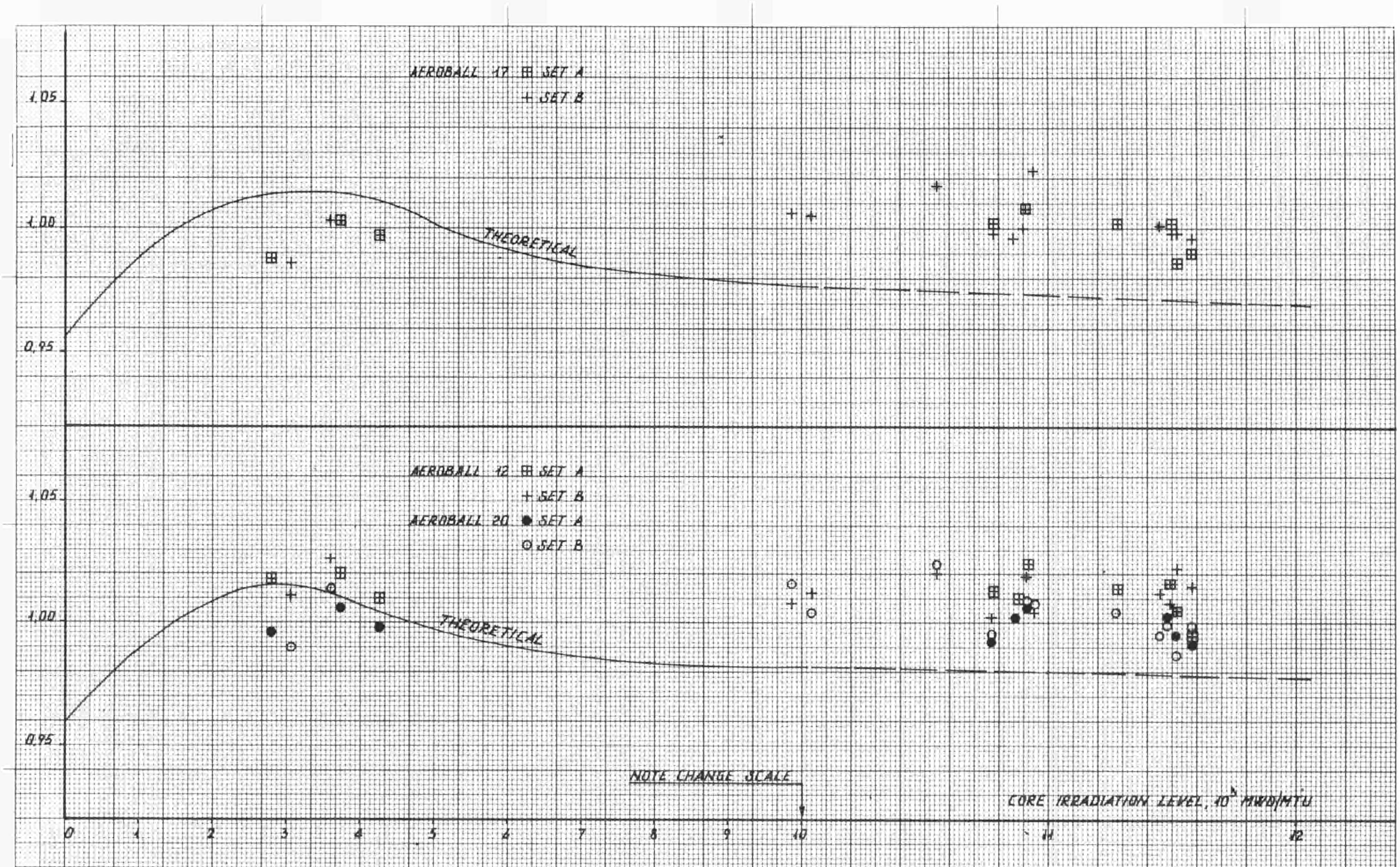


FIG. 1A—RATIOS OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL VS CORE IRRADIATION LEVEL.

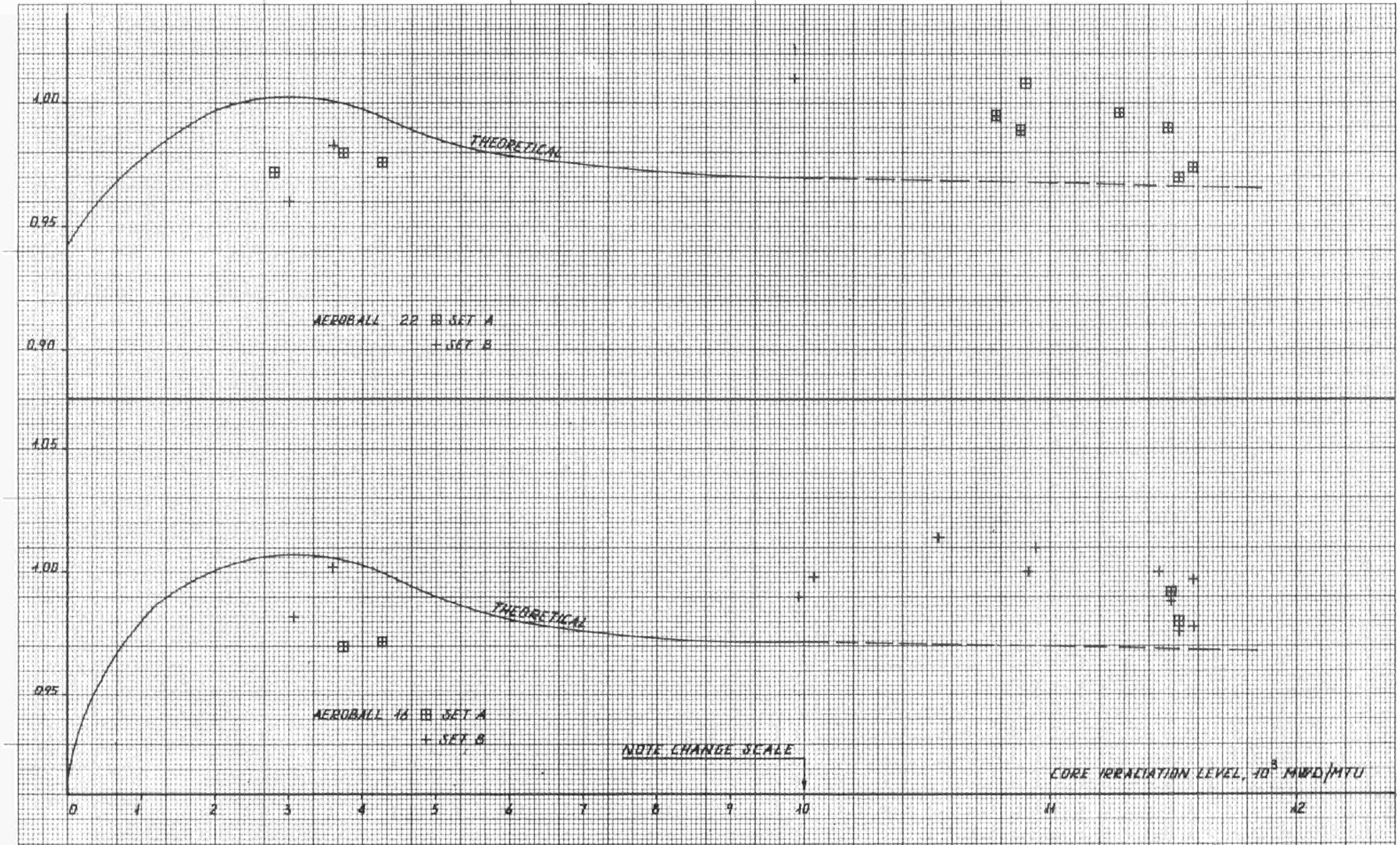


FIG. 18 – RATIOS OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL VS CORE IRRADIATION LEVEL.

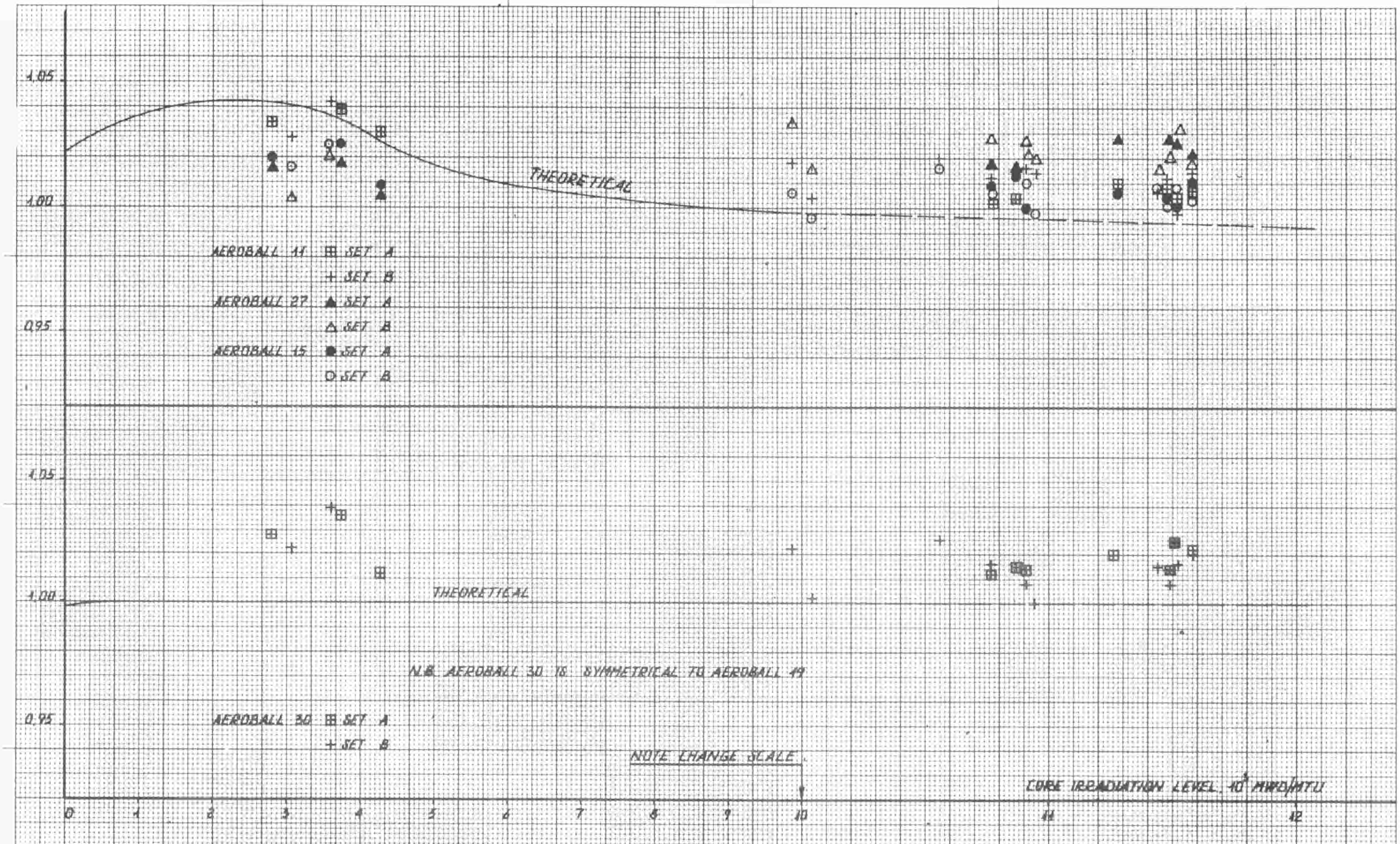


FIG. 1C – RATIOS OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL VS CORE IRRADIATION LEVEL.

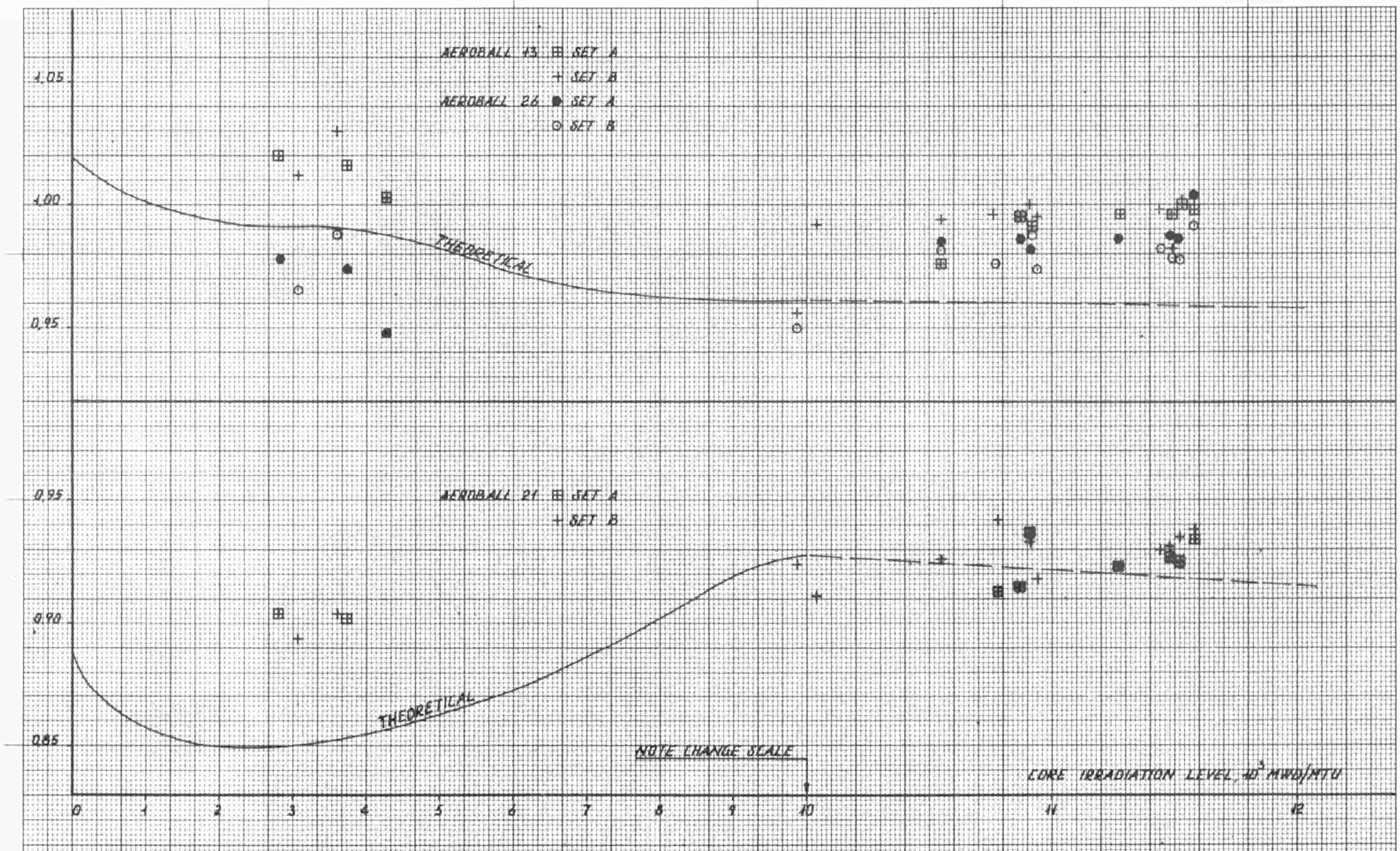


FIG. 10—RATIOS OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL VS CORE IRRADIATION LEVEL.

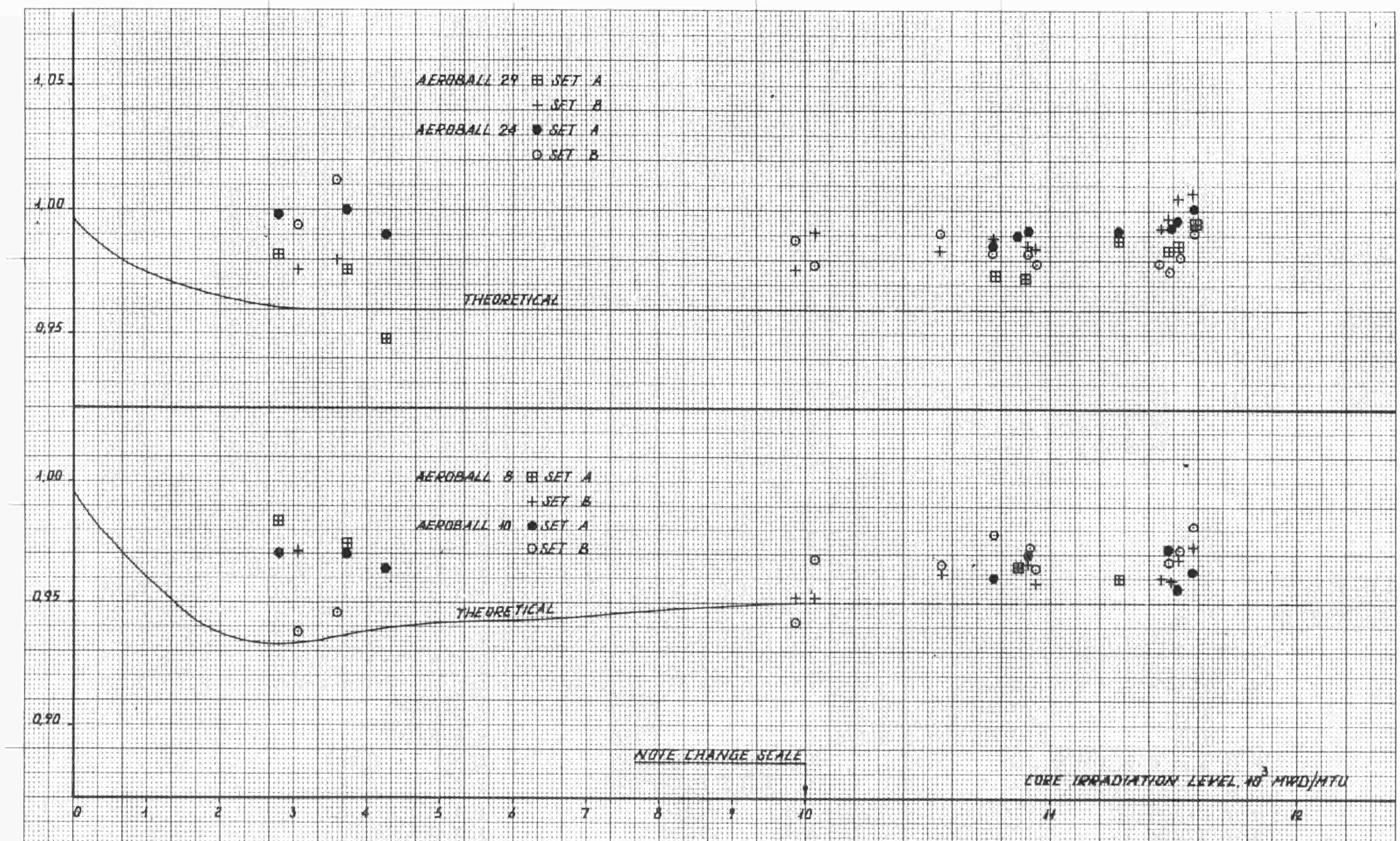


FIG. 1E – RATIOS OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL VS CORE IRRADIATION LEVEL.

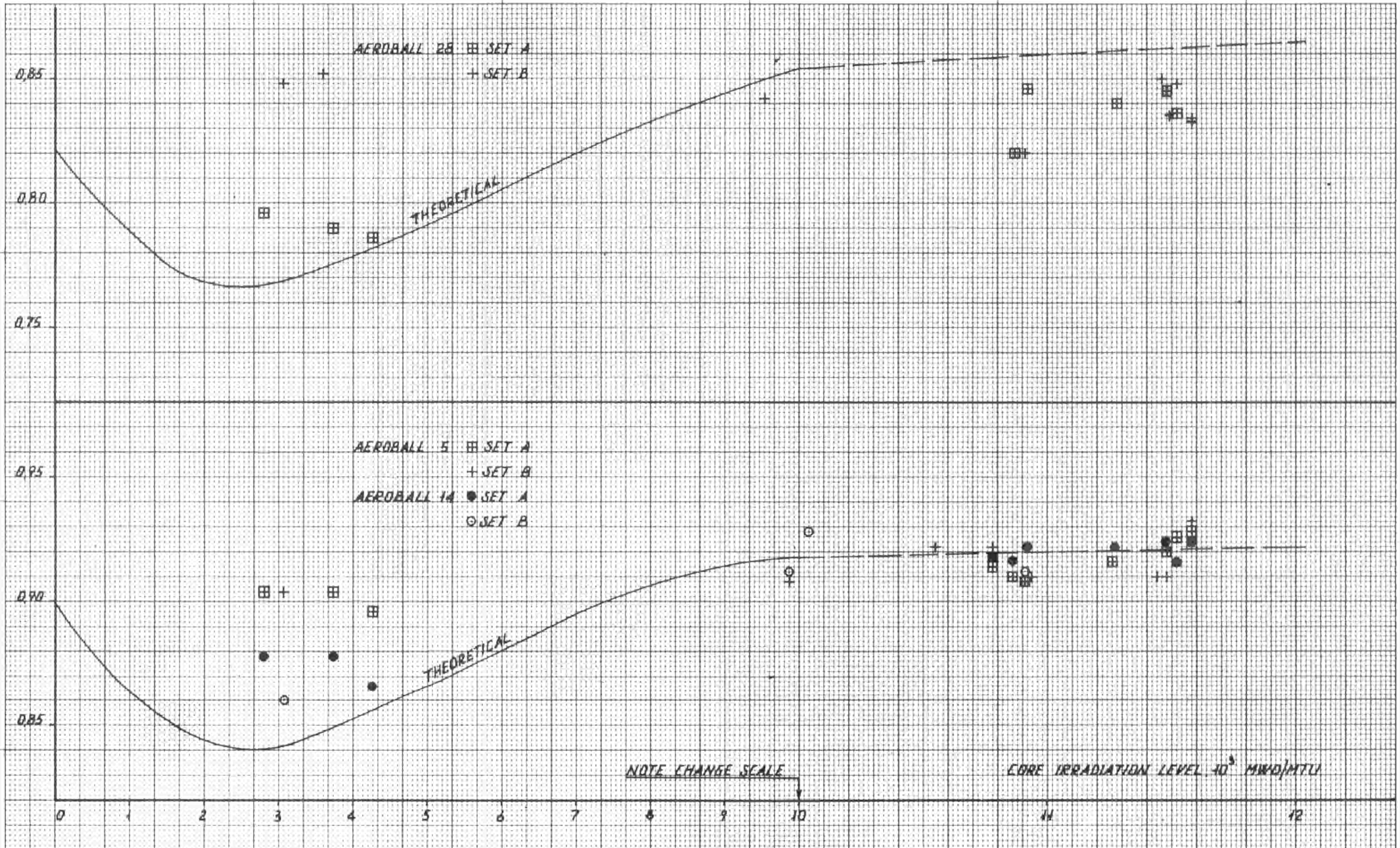


FIG. 4 F – RATIOS OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL VS CORE IRRADIATION LEVEL

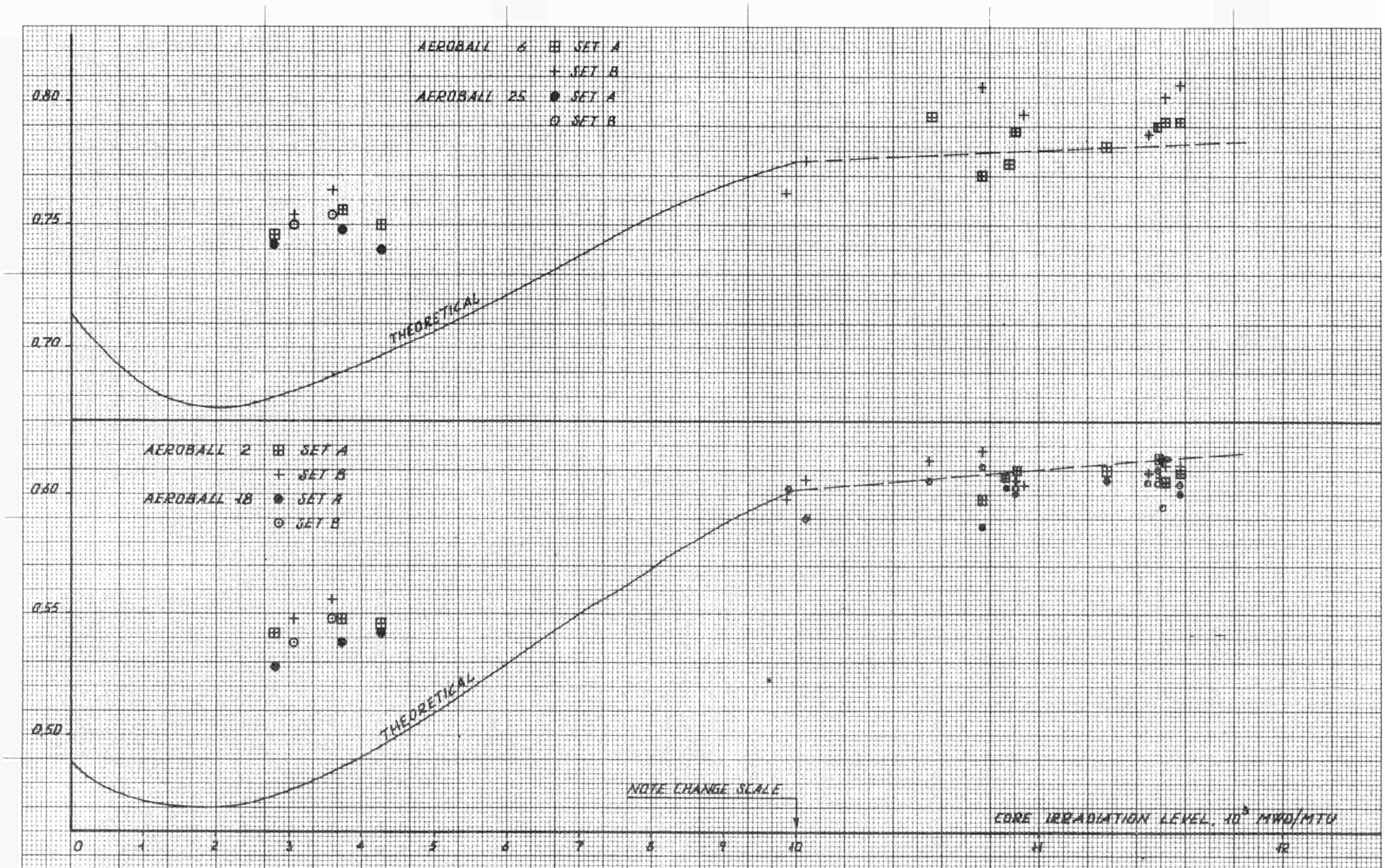


FIG. 10 — RATIOS OF AEROBALL ACTIVITY IN THE REFERENCE AEROBALL VS CORE IRRADIATION LEVEL

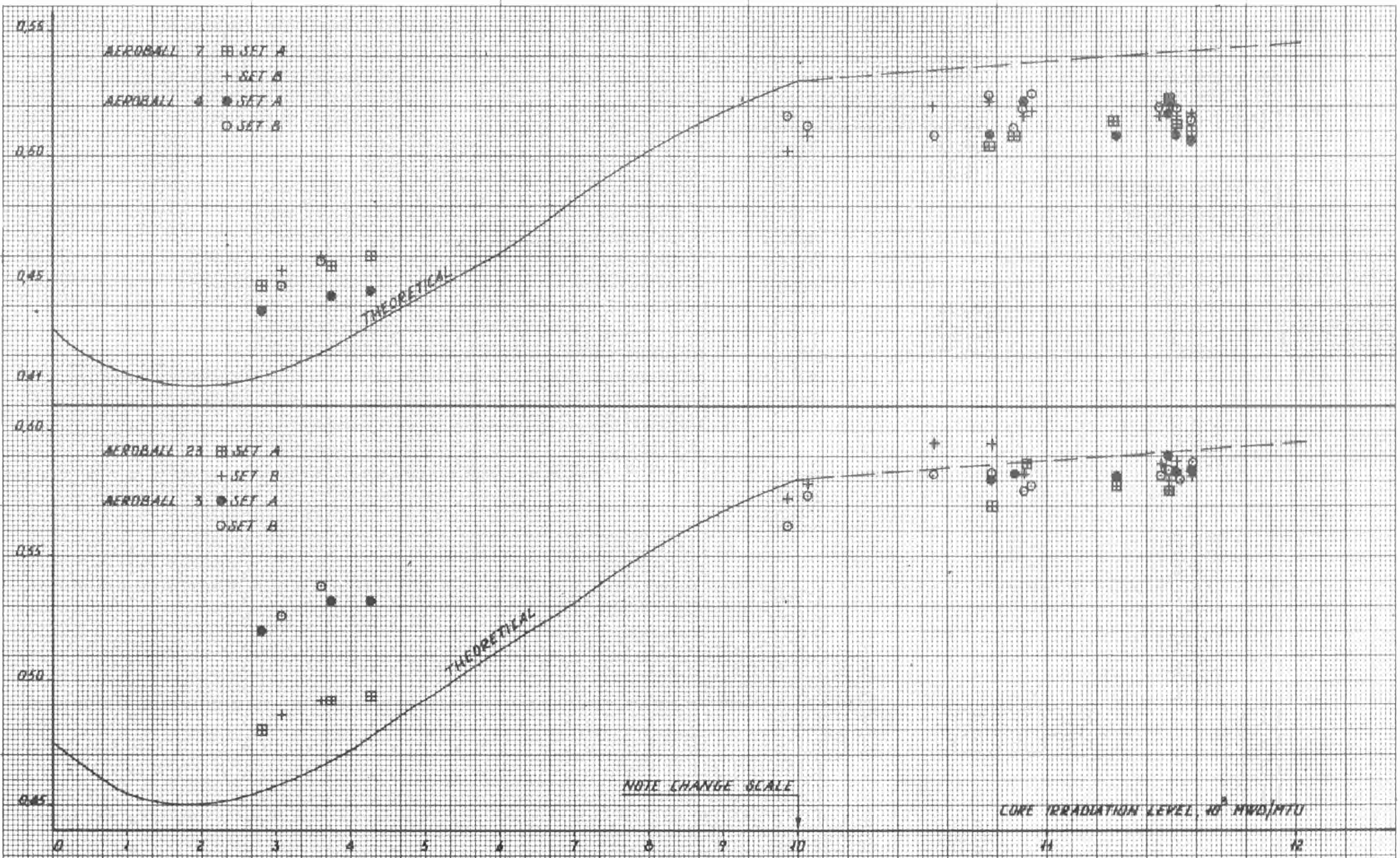
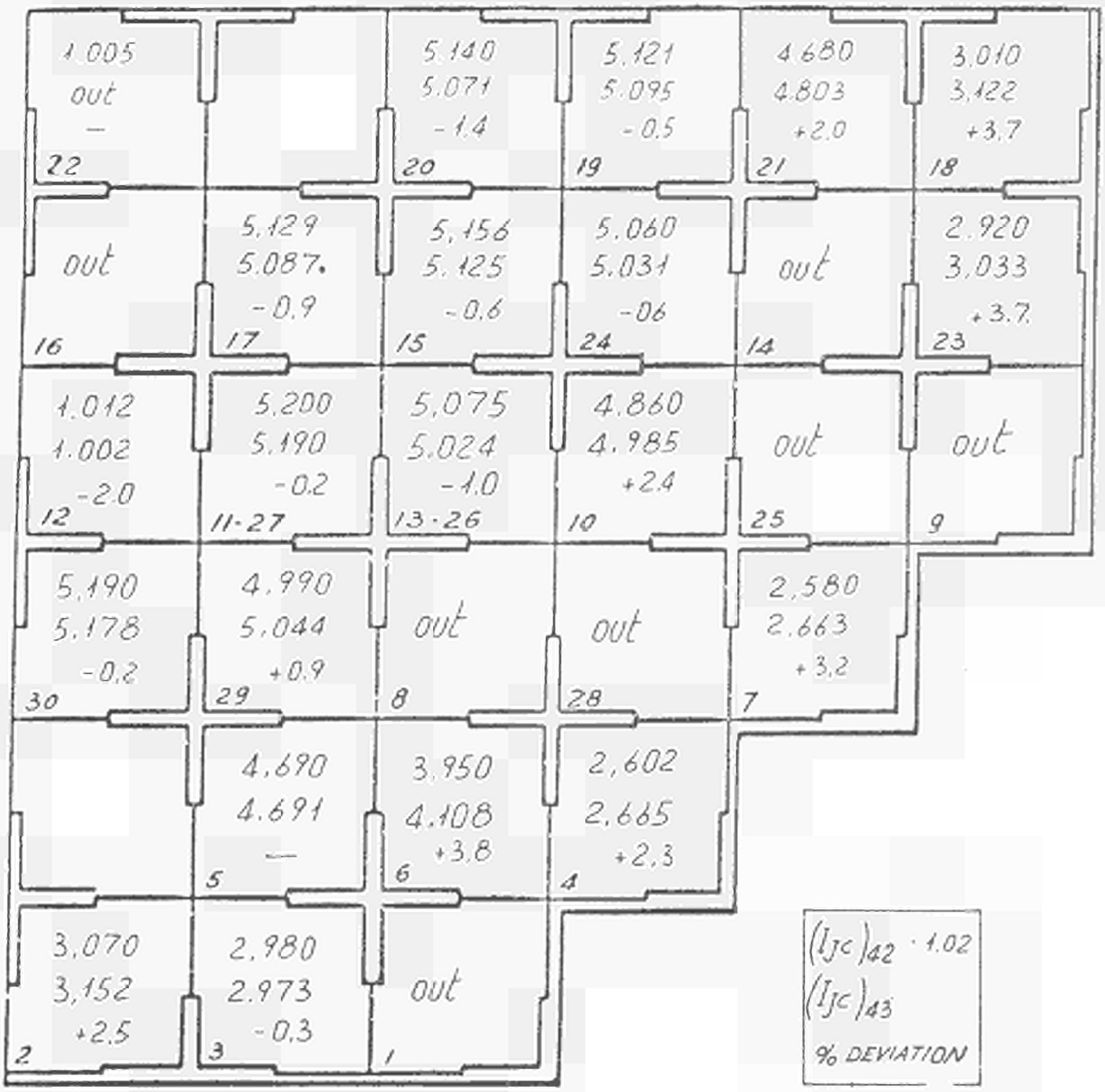


FIG. 4H – RATIOS OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL VS CORE IRRADIATION LEVEL.

FIG 2 – COMPARISON OF ABSOLUTE ACTIVITY VALUES (μA) FROM A.R's 42 A AND 43 B.



A.R. 42 A : Tavg = 276 °C

A.R. 43 B : Tavg = 261 °C

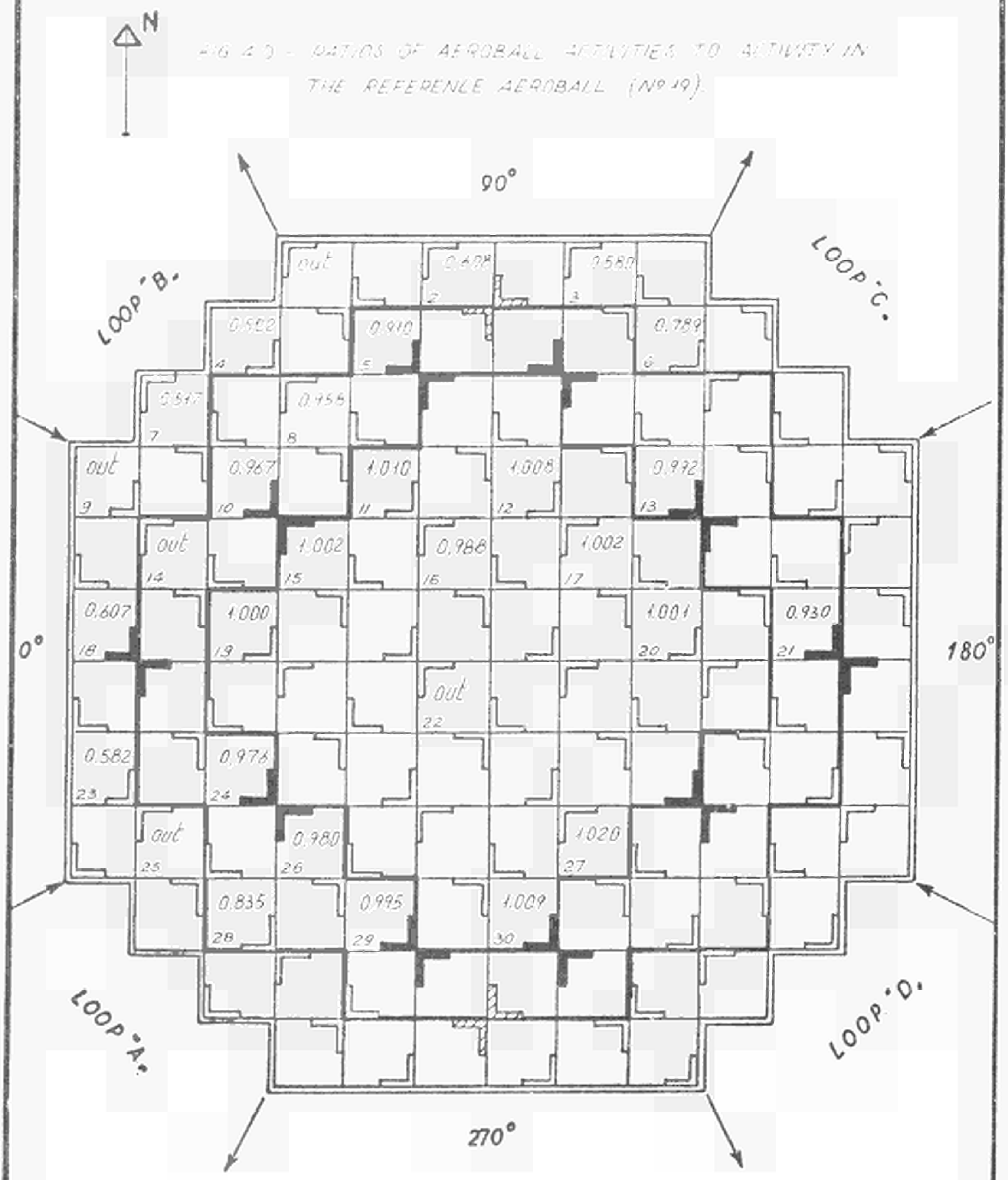
$S_{43}/S_{42} = 1.02$

AVERAGE DEVIATION = 1 %

Aeroball Run Nº	42 A - 43 B
Date	9 - 3 - 1967
Electrical Power Level, MW	255
Control Group Position, steps	263
Trim Group Position, steps	286
Irradiation Level, MWD/MTU	10.763 - 10.771

ENEL - DCTN	
Date: 26 - 5 - 1967	
Dftm: C. A.	App.: Vol

FIG 4.D - RATIOS OF AEROBALL ACTIVITIES TO ACTIVITY IN THE REFERENCE AEROBALL (Nº 19).



Aeroball Run Nº 51 B

Date 14 - 4 - 1967

Electrical Power Level, MW 250

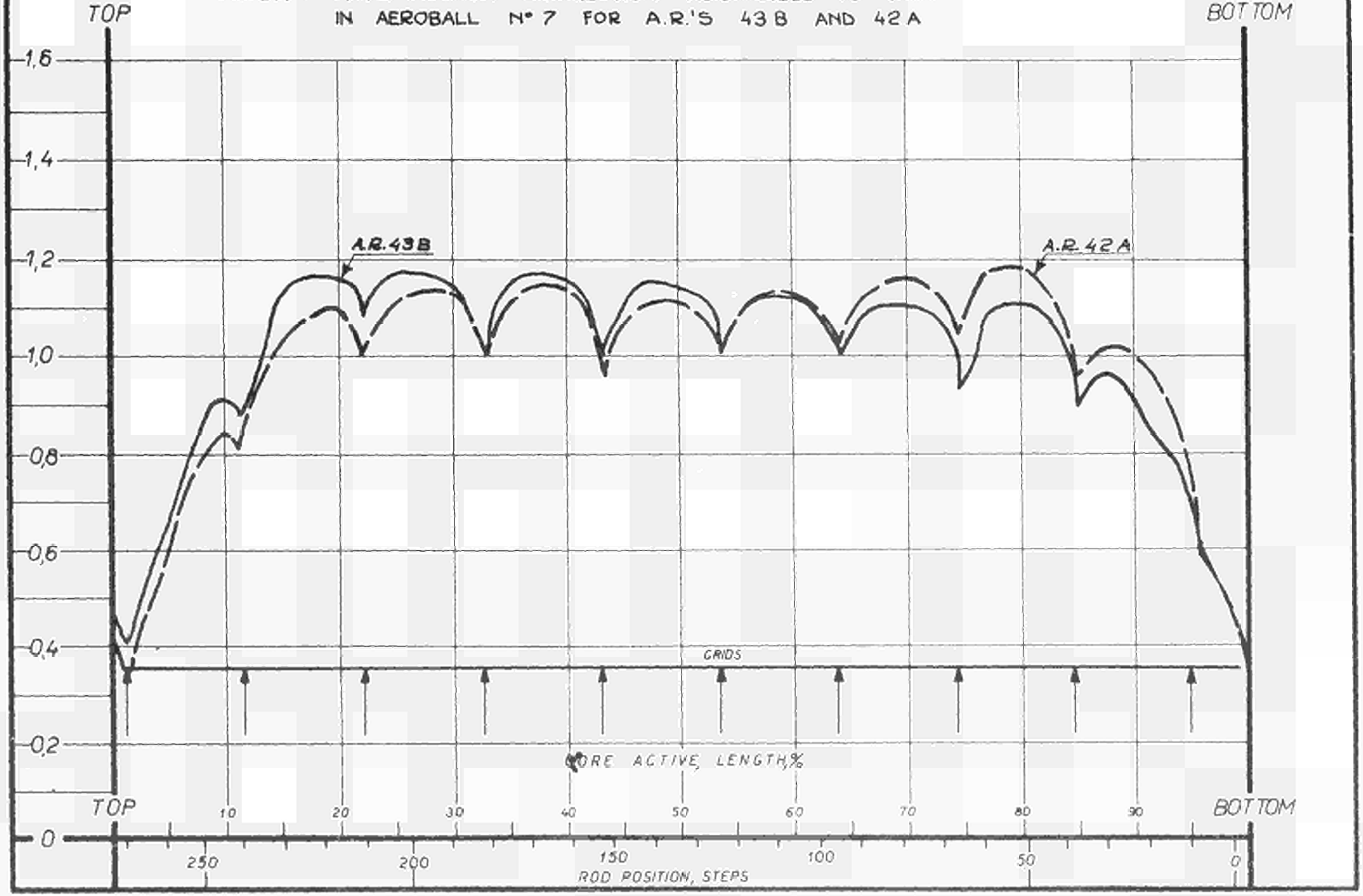
Control Group Position, steps 286

Trim Group Position, steps 286

Irradiation Level, MWD/MTU 11.492

ENEL - DCTN	
Date: 20 - 5 - 1967	
Dftm:	App:

FIG. 5A – AXIAL ACTIVITY DISTRIBUTION NORMALIZED TO UNITY IN AEROBALL N° 7 FOR A.R.'S 43 B AND 42 A



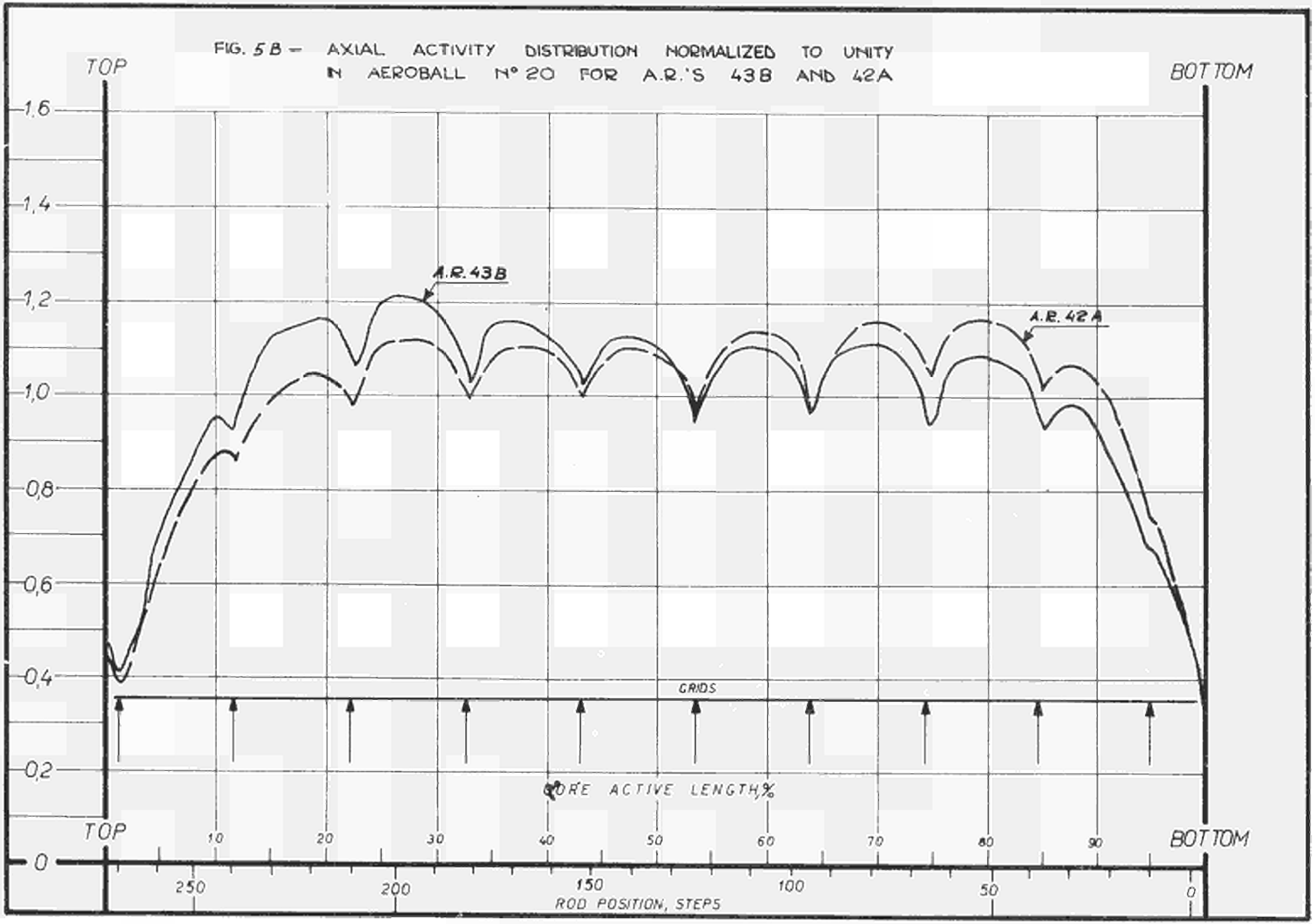


FIG. 5B – AXIAL ACTIVITY DISTRIBUTION NORMALIZED TO UNITY IN AEROBALL N° 20 FOR A.R.'S 43B AND 42A
TOP
BOTTOM
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0
A.R. 43B
A.R. 42A
GRIDS
CORE ACTIVE LENGTH,%
10
20
30
40
50
60
70
80
90
250
200
150
100
50
0
ROD POSITION, STEPS

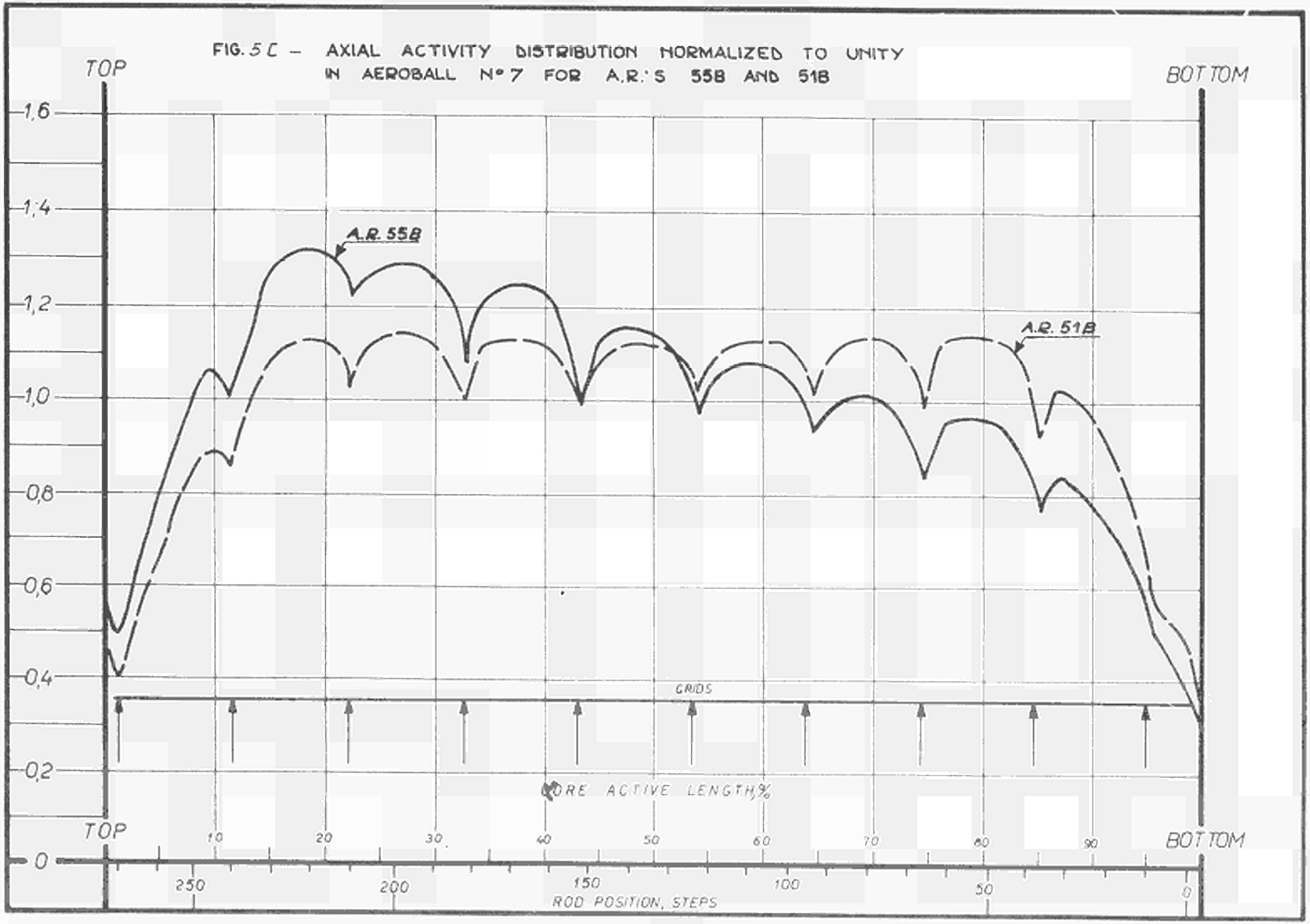


FIG. 5 C – AXIAL ACTIVITY DISTRIBUTION NORMALIZED TO UNITY IN AEROBALL N° 7 FOR A.R.'S 55B AND 51B
TOP
BOTTOM
A.R. 55B
A.R. 51B
GRIDS
CORE ACTIVE LENGTH,%
ROD POSITION, STEPS
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0
10
20
30
40
50
60
70
80
90
250
200
150
100
50
0

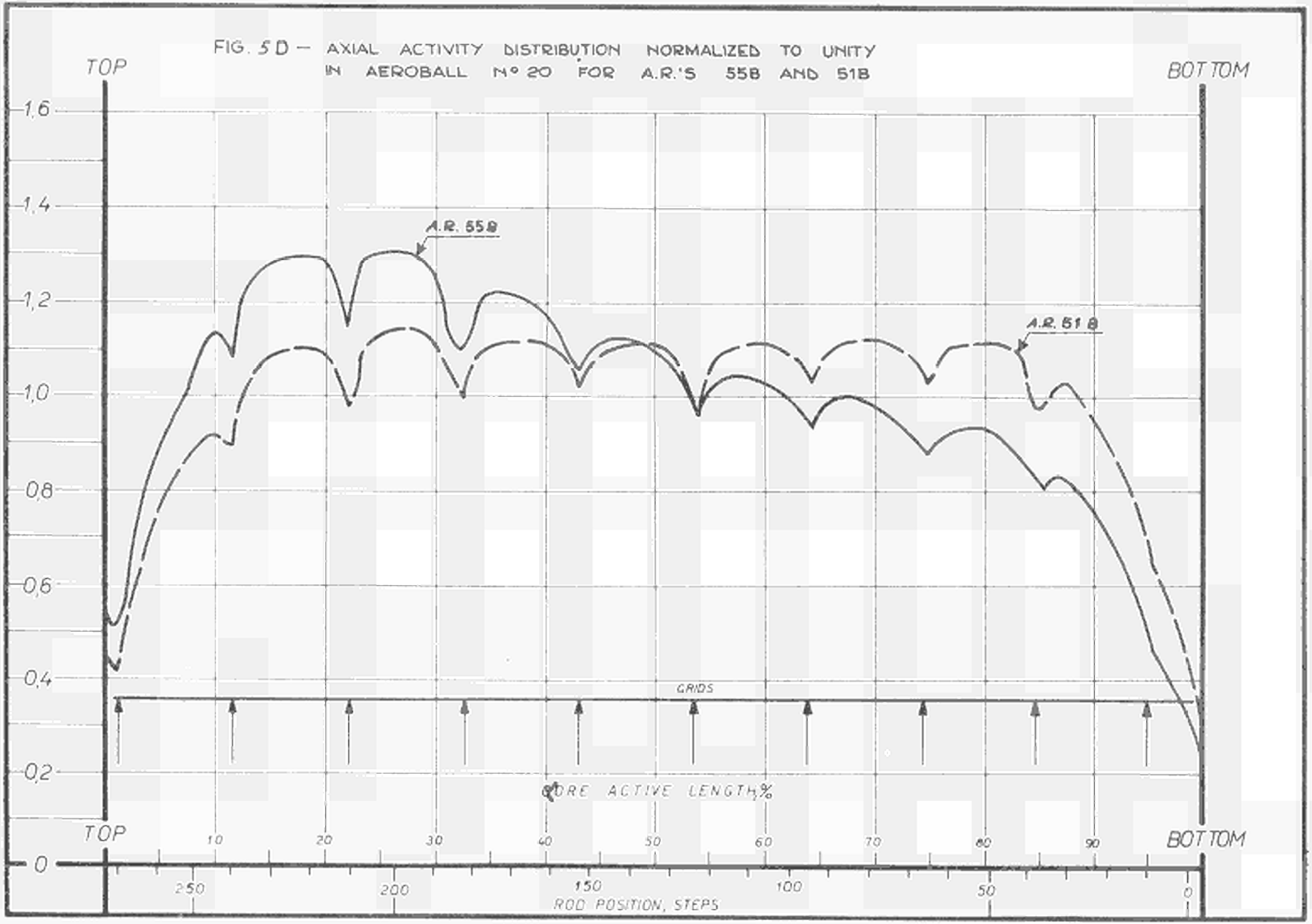


FIG. 5D — AXIAL ACTIVITY DISTRIBUTION NORMALIZED TO UNITY IN AEROBALL Nº 20 FOR A.R.'S 55B AND 51B
TOP
BOTTOM
A.R. 55B
A.R. 51B
GRIDS
CORE ACTIVE LENGTH,%
ROD POSITION, STEPS
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0
10
20
30
40
50
60
70
80
90
250
200
150
100
50
0

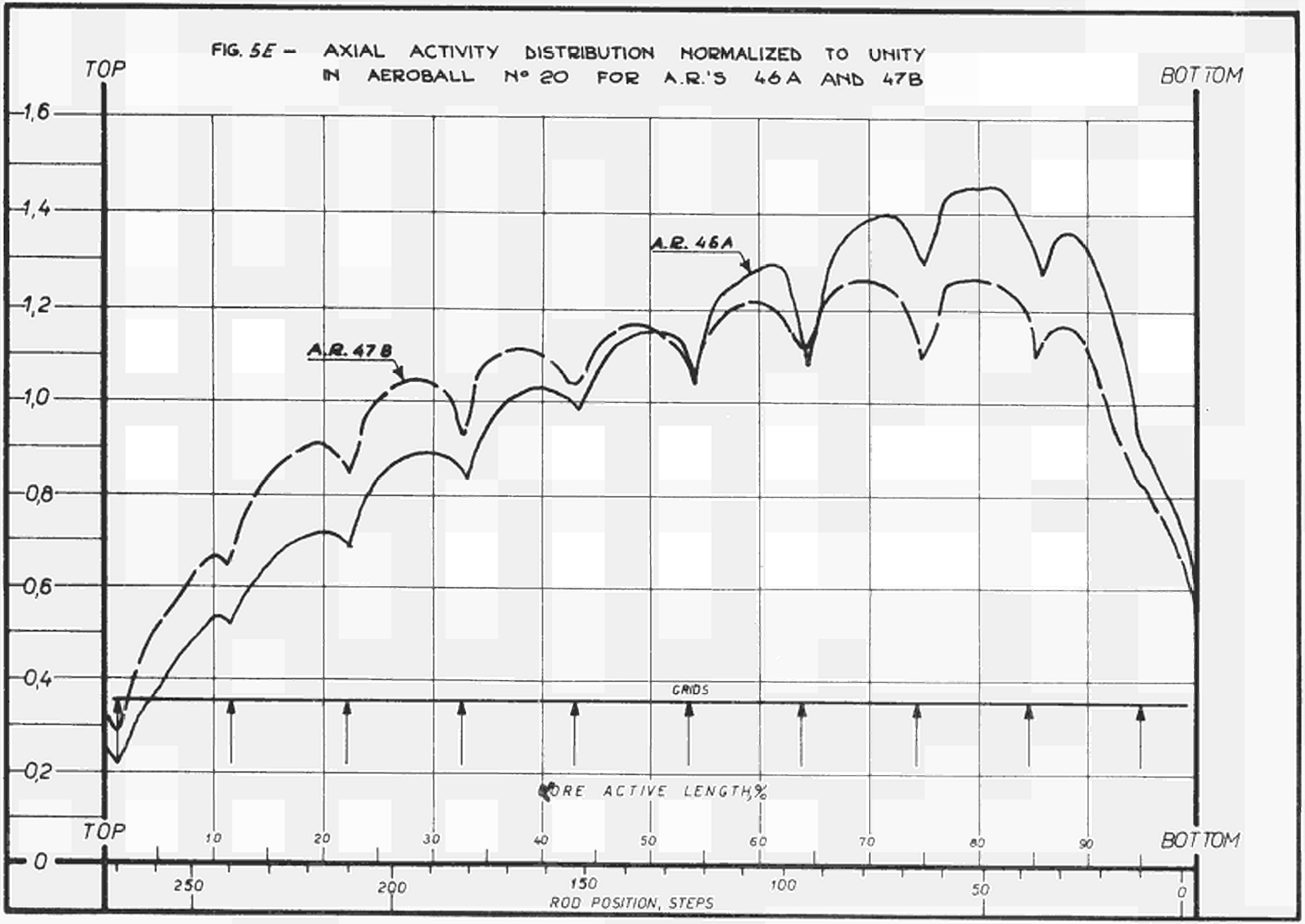


FIG. 5E – AXIAL ACTIVITY DISTRIBUTION NORMALIZED TO UNITY
IN AEROBALL N° 20 FOR A.R.'S 46A AND 47B
TOP
BOTTOM
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0
A.R. 46A
A.R. 47B
GRIDS
CORE ACTIVE LENGTH,%
10
20
30
40
50
60
70
80
90
250
200
150
100
50
0
ROD POSITION, STEPS

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Alfred Nobel

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